M2298K/N

Fixed Disk Unit

Engineering Specification

FUJITSU

BO3P-4580-0401A...01A

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REVISION RECORD		
Edition	**Date published**	**Revised contents**
01	Sept., 1984	
01A	Oct., 1984	Editorial changes on pages 2-1, 3-5, 3-6, 3-9, 4-1, 4-3, 4-8, 5-14, 5-16, 5-17, 5-18, 8-3, 10-1, 10-5, and 10-8
Specification No.: B03P-4580-0401A		

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1. GENERAL DESCRIPTION

This manual describes the M2298 Fixed Disk Unit. This unit contains non-removable disks in sealed modules. A rotary actuator is used for the positioning mechanism of each unit.

The unit is designed to be mounted in a 19-inch Standard Rack (6 pitch).

The contact start/stop (CSS) type heads and media are of the Winchester technology type. These units feature high performance, high reliability, and low cost.

The storage capacities of the M2298 is 671MB (unformatted). For the FDU M2298, Fixed Sector format is available and the interface is designed for easy and effective system operation.

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2. FEATURES

(1) High Reliability

a) Winchester type technology contact-start-stop (CSS) heads and media are employed.

b) The rotary actuator features low power consumption, no head loading mechanism and no head adjustment.

c) The heads, media and rotary actuator are sealed in a closed-loop air system.

d) Head positioning is performed by a servo track-following method utilizing servo data written on the bottom disk surface.

e) Within the sealed disk enclosure (DE), the electric parts and assemblies are minimized.

f) Dual port option
The M2298 can be connected with two controllers when a dual port option is provided. This option is available as a separate printed circuit board which is mounted on the PCB chassis.

(2) High Storage Capacity

The M2298 has an unformatted 671MB storage capacity which has been obtained by five platters, using highly reliable Winchester technology.

(3) Maintainability

The M2298 requires no periodic preventive maintenance.

(4) Small size and Light Weight

The M2298 can be installed in a 19" standard cabinet with 6-pitch.
The weight is approximately 45 kg (100 lbs.)

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3. SPECIFICATION

3.1 Operational Specification

Table 3-1 Operational Specification

Unformatted Storage Capacity	671,088,640 Bytes
Cylinder/Unit	1,024
Track/Cylinder	16
Number of Platters	5
Unformatted Track Capacity	40,960 Bytes
Single Track Positioning Time	6 ms
Average Positioning Time	27 ms
Maximum Positioning Time	55 ms
Rotational Speed	2,722 rpm
Average Latency Time	11.02 ms
Bit Density	13,000 BPI (8,600 FRPI)
Track Density	793 TPI
Transfer Rate	1,859 KB/s
Recording Code	RLL2, 7
Interface Code	NRZ
Start Time	40 sec nominal
Stop Time	30 sec nominal

3.2 Physical Specification

Table 3-2 Physical Specification

Characteristics	Condition	Specification
Dimension	Height	9.8" (250mm)
	Width	16.4" (416mm)
	Depth	25.6" (650mm)
Weight	(Without options)	Approx. 100ℓbs (45Kg)
Temperature	Operating	5°C to 40°C (41°F to 104°F)
	Non-operating	-40°C to 60°C (-40°C to 140°F)
	Gradient	Less than 15°C/Hr (Less than 27°F/Hr)
Relative Humidity	Operating	20% to 80%
	Non-operating	5% to 95% (without condensation)
Vibration	Operating	0.2G max (5 Hz to 50 Hz) 1.0G max (50 Hz to 500 Hz)
	Non-operating	3.0G max (when the transportation fixtures are attached)
Shock	Operating	Less than 2.0G
	Non-operating	Less than 5.0G
Altitude	Operating	10,000 feet
	Non-operating	40,000 feet

3.3 Power Requirement

3.3.1 DC Power Requirement

The M2298 requires the following DC powers as described in Table 3-3.

Table 3-3 DC Power Source Specifications

Voltage	Load Current	
	Basic Unit	Basic Unit with dual port option
+5V ± 5%	4.2A max	5.15A max
+12V ± 5%	0.43A max	0.43A max
-12V ± 5%	2.9A max	3.28A max
+24V ± 20%	3.8A max*	3.8A max*

The DC power load currents of +5V, +12 and -12V are stable, the load current of +24V, however, is fluctuated by the seek operation as shown in Figure 3-1.

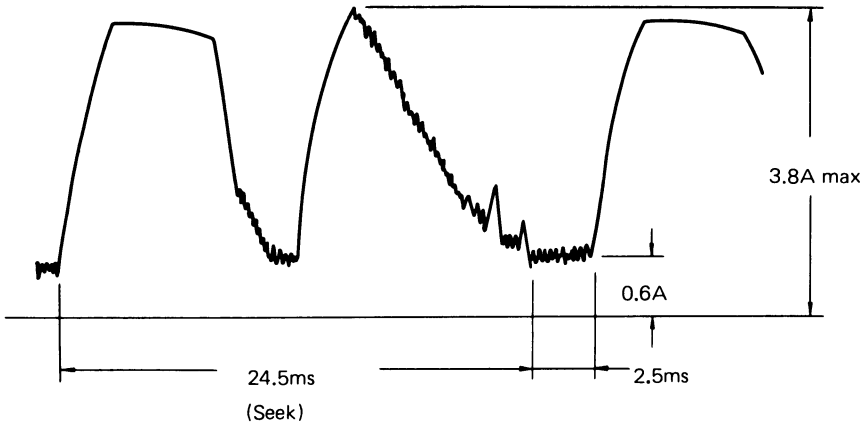


Figure 3-1 +24V Load Current (Worst case)

3.3.2 AC Power Requirement (Basic Drive)

The M2298 requires AC powers which are applied to the spindle motor and the blower as shown in Table 3-4.

Table 3-4 AC Power Requirement

	AC Voltage	Frequency	Run Current	Start Current
K model	100V ±10%	50/60Hz +1% -3%	2.5A max	9.0A max
	115V +15% -10%	60Hz ±1%	3.0A max	10.5A max
N model	AC220V +22V -25V and AC100V +32V -10V	50Hz +1% -2%	2.0A max 0.3A max	5.0A max
	AC240V +24V -27V and AC100V +32V -10V	50Hz +1% -2%	2.0A max 0.3A max	5.0A max

Note) The M2298K is rated for AC100V/115V input, the M2298N, however, is rated for AC220V/240V (spindle motor) and for AC100V (blower). The load current profile during power up sequence is shown in Figure 3-2.

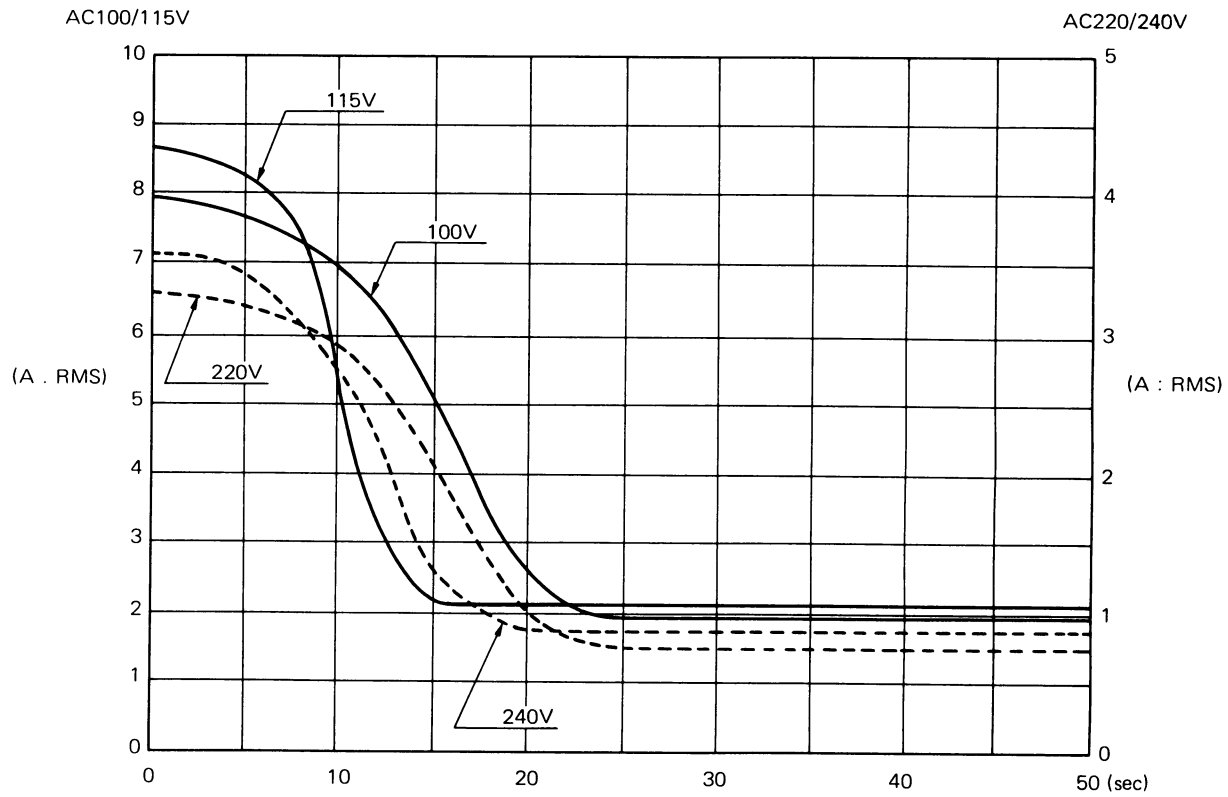


Figure 3-2 Load Current Profile at Power up Sequency (Basic Drive)

3.3.3 AC Power Requirement with Optional Power Supply

The two optional power supply units are provided with M2298K/N models. The AC power requirement for the drive with an optional power supply is shown in Table 3-5, and the load current profile of the drive with the power supply is shown in Figure 3-3. The optional power supply unit is able to supply all AC/DC power required in 3.3.1 and 3.3.2.

Table 3-5 AC Power Requirement including Power Supply Unit

	AC Voltage	Frequency	Run Current	Start Current
K model	AC100V±10%	50/60Hz $^{+1\%}_{-3\%}$	4.1A nominal	9.6A nominal
	AC115V $^{+15\%}_{-10\%}$	60Hz ±1%	4.3A nominal	10.4A nominal
N model	AC220V $^{+22V}_{-25V}$	50Hz $^{+1\%}_{-2\%}$	1.8A nominal	4.5A nominal
	AC240V $^{+24V}_{-27V}$	50Hz $^{+1\%}_{-2\%}$	1.9A nominal	4.7A nominal

The load current profile of M2298 including an optional power supply unit.

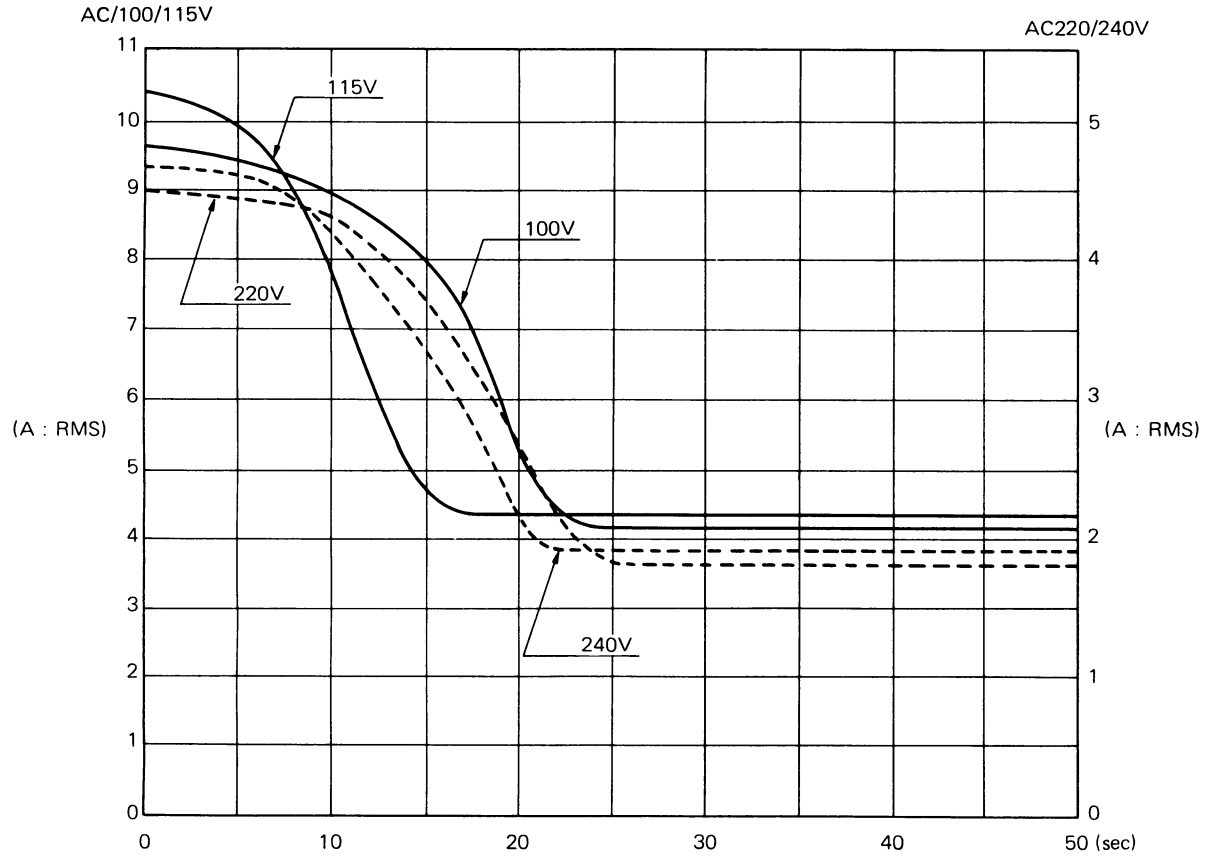


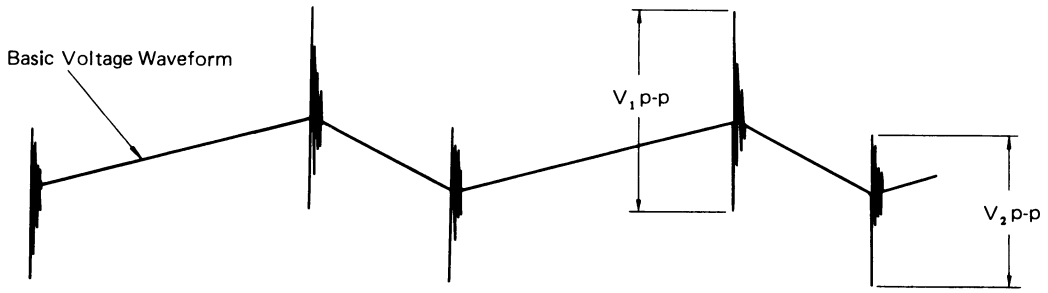
Figure 3-3 Load Current Profile at Power-up Sequence (including Power Supply Unit)

3.3.4 High Frequency Noise Specification

When the DC power is supplied to the drive from a customer power supply with switching type regulation, the high frequency noise caused by the switching regulator should be specified as follows:

1) High Frequency Noise Definition

It is defined that the High Frequency Noise is caused by a switching transient on basic voltage within the switching type regulator on the power supply unit as shown in Figure 3-4.



Note) A noise is higher one between V_1p-p and V_2p-p.

Figure 3-4 High Frequency Noise

2) Measurement Procedure

A noise level should be measured on terminals of the power supply as shown in Figure 3-5.

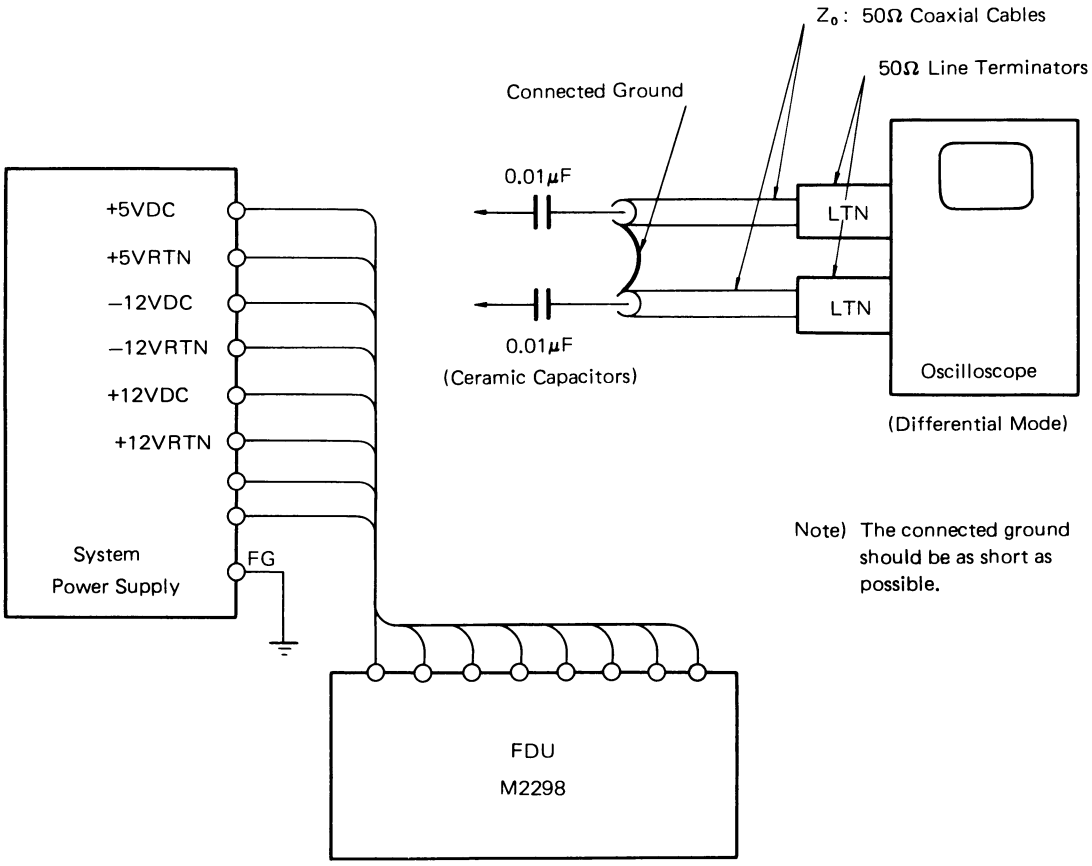


Figure 3-5 Measurement Procedure

3) Noise Specification

a. Noise between each DC output and return terminals.

V_{N1} : 0.1 V_{p-p} max.

b. Noise between each terminal (DC output and return) and Frame Ground (FG).

V_{N2} : 1.0V max.

c. This specification is not applied to an external line noise definition.

3.4 Positioning Time

The positioning time profile between a next cylinder address and a current cylinder address is shown in Figure 3-6.

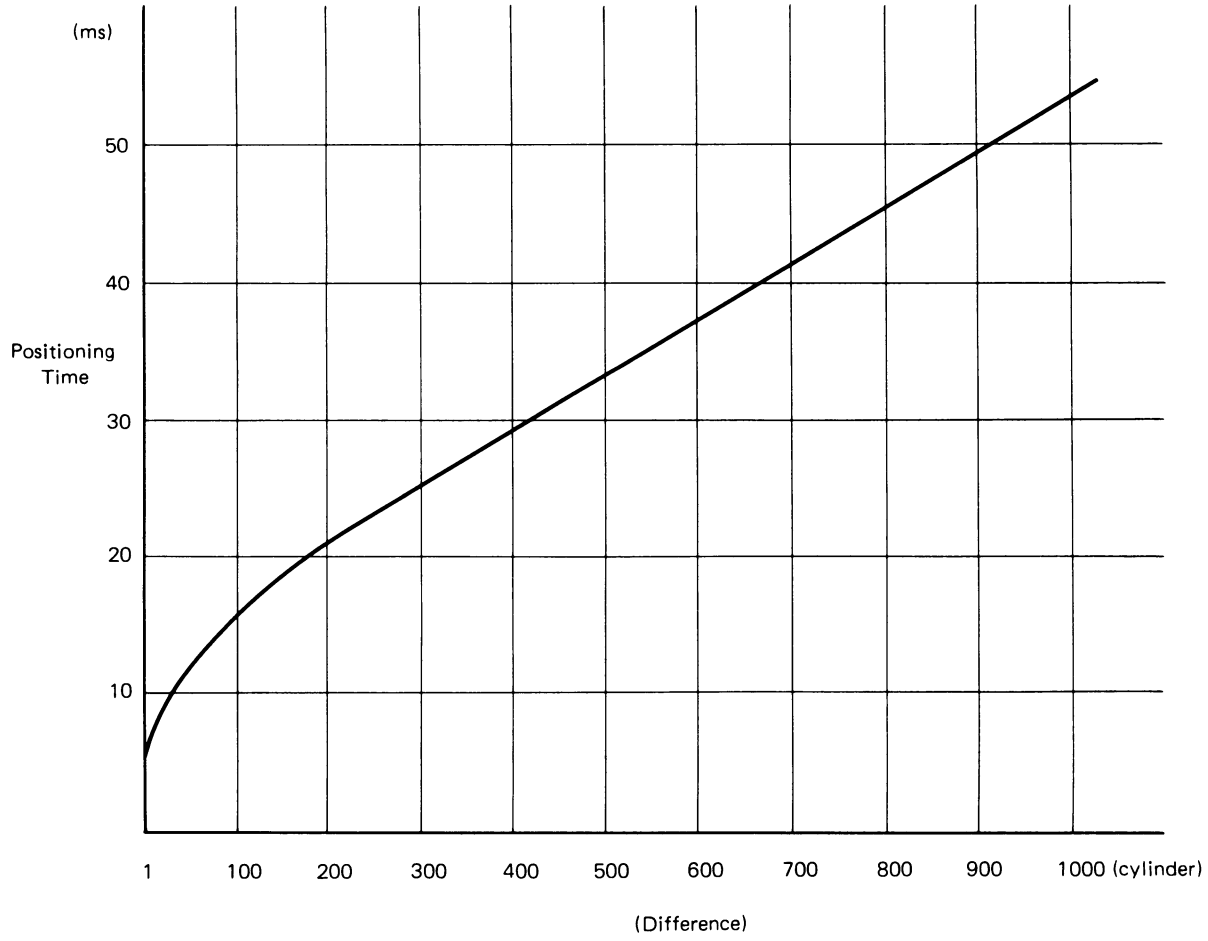


Figure 3-6 Positioning Time Profile

3.5 Reliability

(1) Mean-Time-Between-Failure (MTBF)

MTBF is defined as follows:

$$MTBF = \frac{\text{Operating Hours}}{\text{Number of equipment failures}}$$

Operating hours include all the power-on time, excluding maintenance time. Equipment failures mean failures which require any repair, adjustment and replacement, excluding failures caused by operator error, power failure, controller error, cable failure or unsuitable environmental conditions.

The MTBF of the FDU shall exceed 20,000 hours (engineering specification).

(2) Mean-Time-To-Repair (MTTR)

MTTR is defined as the time for an adequately trained and competent serviceman to diagnose and correct a **malfunction.** The MTTR of FDU shall not exceed 1 hour (engineering specification).

(3) Service Life

The FDU is designed and manufactured to provide a useful life of 5 years.

(4) Power Loss

Should AC or DC power failure occur, the heads are automatically returned to the landing zone to prevent the contact start/stop heads from landing in the data recording zone.

3.6 Data Integrity

The error rate does not include errors which are detected at initialization and are corrected for by assigning alternate tracks.

(1) Recoverable error rate

A recoverable error is one which can be read correctly within one retry command (four retries) and should not exceed one per 10^{10} bits.

(2) Non-recoverable error rate

A non-recoverable error is one which cannot be read correctly within four retry commands (sixteen retries) and should not exceed one per 10^{13} bits.

(3) Positioning error rate

The positioning error which can be corrected within one retry and should not exceed one per 10^{7} seeks.

(4) Media defects

A media defect is defined as a repeative read error that occurs on a properly adjusted drive within specific operating conditions.

Valid data must not be written over known media defects, therefore, sector/track deallocation or skip displacement techniques must be utilized.

A. Media defect characteristics

(a) The maximum number of defects per drive is as follows:

800

(b) The maximum number of defective tracks per drive is as follows:

48

A defective track is defined as a track having any of the following:

- Two to four defects
- Defective logging areas

Note: No track shall have more than four defects.

B. Media defect free areas are defined as follows:

(a) Cylinder 0, Head 0 through 2

(b) Any error in logging area to extent defined in the Media Defect Format.

(5) Media Defect Information

All FDU will have a Media Defect List which will list the following information.

(a) Cylinder Address
(b) Head Address
(c) Position (bytes from Index ±1 byte)
(d) Length bits ±1 bit

The above information will be listed by hexadecimal code. The maximum media defect length at a defect is 64 bytes (512 bits).

(6) Media Defect Format (Optional)

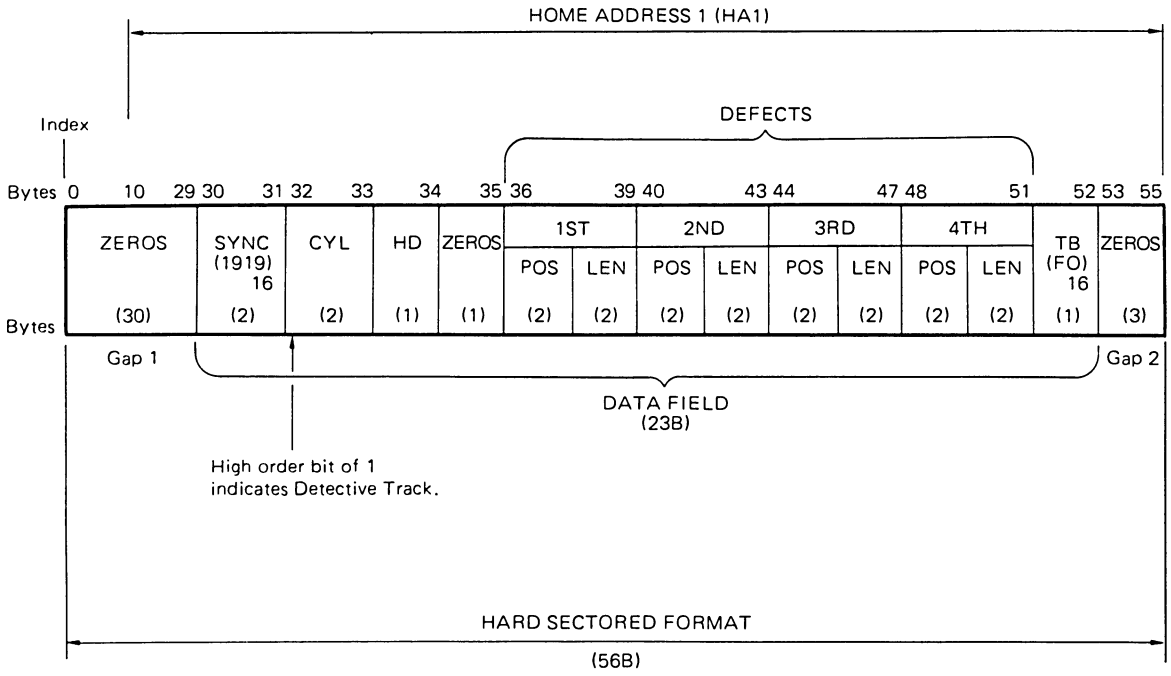
The FDU will be formatted at the factory with the standard Media Defect Format. The Media Defect Format is a hard-sectored format and is normally included in the first 56 bytes following Index signal. The format rule is shown as follows;

A. A track which has more than one defect is defined and flagged as a defective track. The first four media defects are logged.

B. If the beginning of a defect is located between Byte 10 to Byte 55 (HA1) after Index, 60 bytes of zeros are added to gap 1 (90 bytes total).

In this case, if any part of a defect is located between Byte 69 and Byte 115 (HA1), the track is flagged as defective. Refer to Figure 3-8 Format 2.

C. If the track is defined as a defective track according to above-mentioned Rule A or B, the high order bit of the first cylinder address byte is set to 1. Remaining information may or may not be valid.



Note 1) Position (POS) of defect is in bytes after Index ±1 byte.
2) Length (LEN) of defect is in bits ±1 bit.
3) Unused defect locations are all zeros.

Figure 3-7 Media Defect Format 1

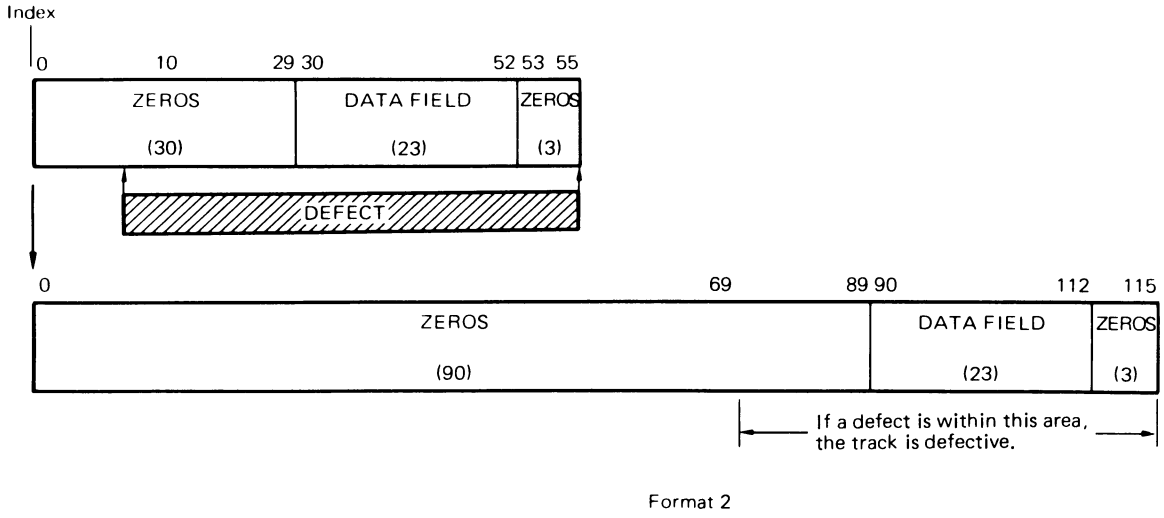


Figure 3-8 Skip Displaced Format

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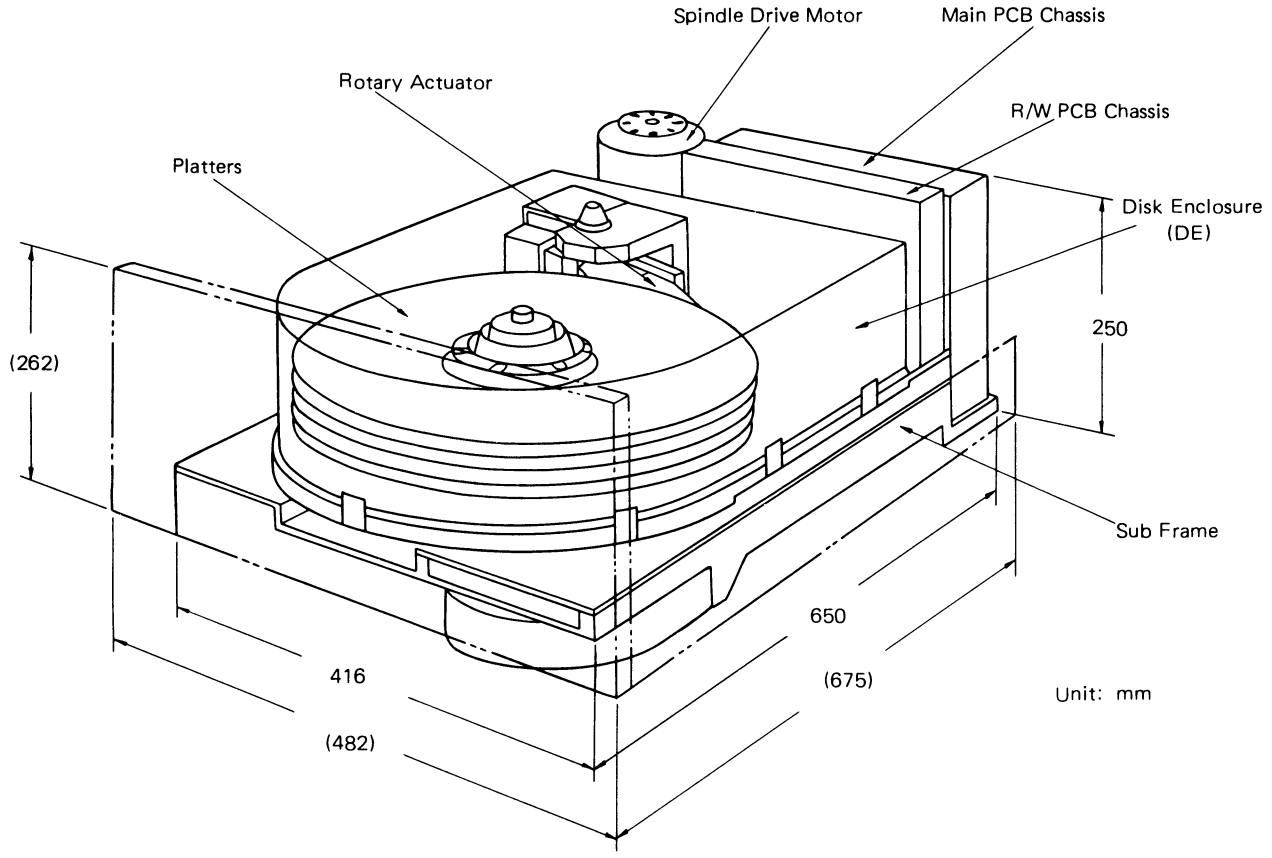
4. EQUIPMENT CONSTRUCTION

4.1 Equipment Definition

The FDU Model M2298 is 2,722 rpm, 1,859 KB/sec data transfer rate, random-access, fixed media device consisting of a drive motor and brake; electronic printed circuit boards with read/write, servo control and driver/receiver electronics; and disk enclosure (DE) containing disk, heads, rotary actuator and air filters with a sealed cover (Figure 4-1).

The FDU includes several features to enhance system integrity, which are phase-locked data separation (VFO), NRZ to RLL2, 7 data conversion with write compensation, sector number selecting and daisy-chain interface capability.

The FDU is designed to be rack mounted in either domestic or European enclosures (see Figures 5-1 and 5-2) or to be vertically-mounted in a built-in system (see Figure 5-3).



Note: The dimensions in parentheses are for the FDU with a front panel and rack mount slides.

Figure 4-1 Equipment Layout

4.2 Major Components

(1) Disk Enclosure (DE)

The disk enclosure is a completely sealed unit containing disks, spindle, actuator and heads.

This enclosure is sealed in the factory and must not be opened in the field.

The DE is treated as one maintenance part.

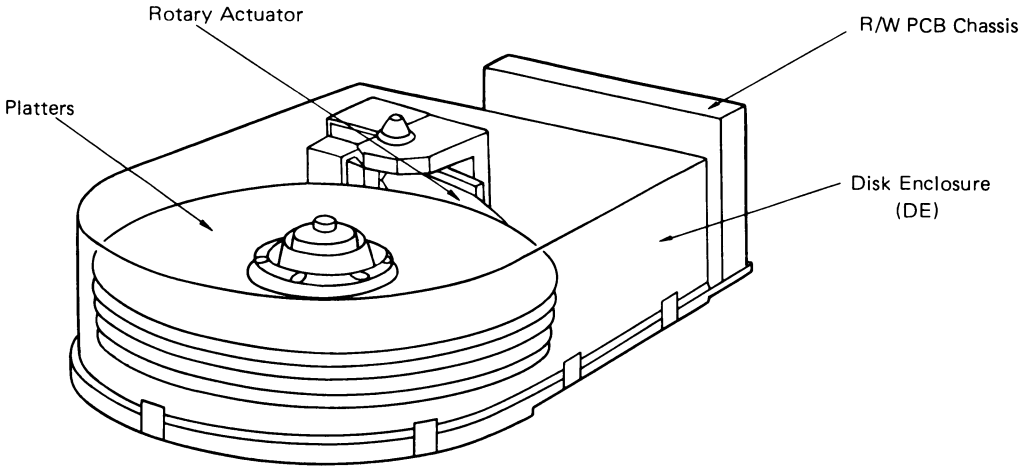


Figure 4-2 Disk Enclosure

(2) Spindle Assembly

The disk spindle is mounted in the DE housing in the bottom of the disk enclosure. The housing is sealed to prevent air from entering through the bearings. A hub is attached to the top of the spindle, and disks (recording media) are clamped to the hub. A pulley is attached to the bottom of the spindle and is driven by the disk drive motor and a flat belt. The spindle and belt are grounded to the DE body through a spindle locking arm.

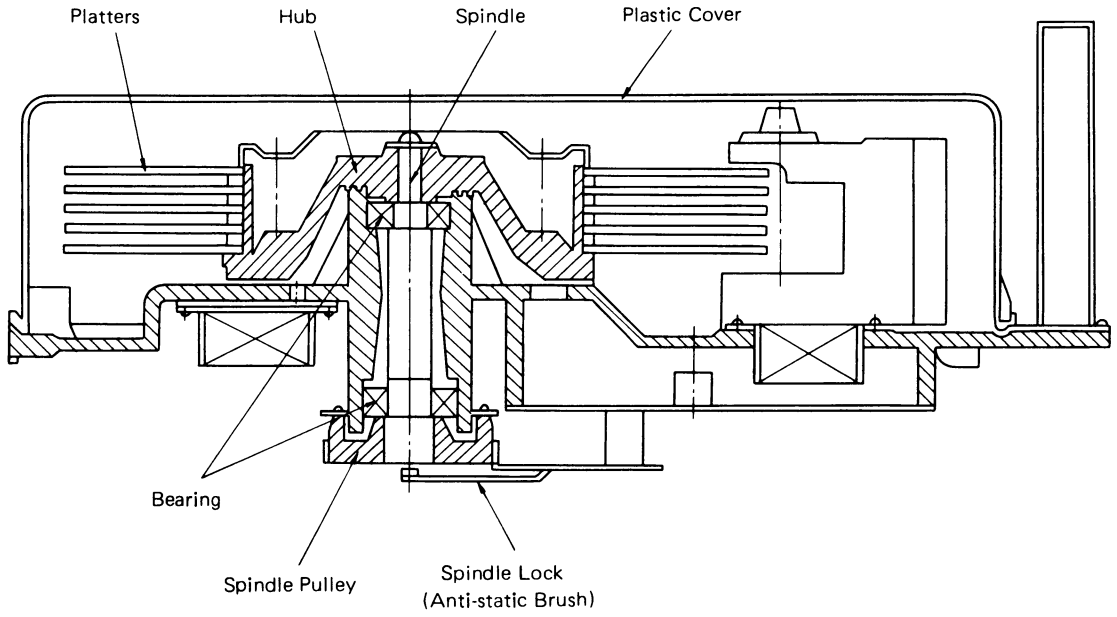


Figure 4-3 Spindle Assembly

(3) Disk drive motor and brake

As this fixed-disk unit uses contact start/stop heads, the head-disk contact time must be minimized during rotation. Therefore, the disk drive systems uses a thermally protected high torque motor for quick acceleration to nominal rotation speed and a brake for quick stopping.

Should overheating occur, the AC power to the motor is automatically disconnected and the disk rotation speed is gradually decreased. In this case the alarm signal is not sent to the power unit. When the temperature drops to an acceptable level, the motor will recover to nominal speed.

A flat belt connects the disk drive motor to the spindle.

The motor is mounted on a pivot, and sufficient tension is supplied to the belt by pulling the motor with a spring.

A brake is mounted at the top of the motor. This brake is actuated when the DC +24V is turned off. When the current at the brake coil is turned off, the brake pad is pushed to the brake plate by the spring and stops the motor.

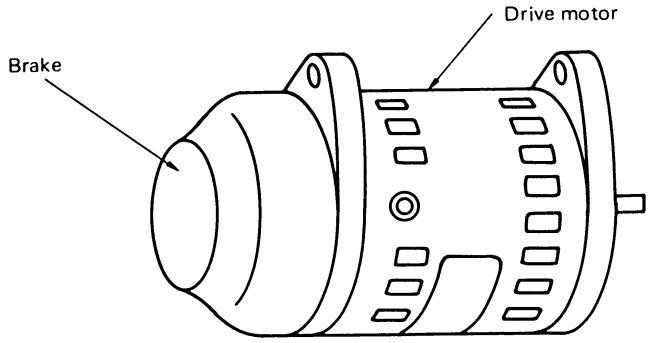


Figure 4-4 Disk Drive Motor and Brake

(4) Actuator Arm Assembly

A rotary type actuator with low power consumption and low heat dissipation is used to move the data heads and servo head to the specified cylinder along a circular arc.

A moving coil is attached to the other end of the actuator arm and moves freely between fixed permanent magnets without contact. When current is applied to the coil, interaction occurs between the coil and magnet and the actuator moves around the pivot.

The actuator performs the following types of motion, which are controlled by servo feed-back current from the servo head:

(1) Positioning

Heads are moved to the specified tracks.

(2) Track following

Heads follow the specified tracks to prevent mispositioning from disturbances such as shock or vibration.

The servo head is located on the lower surface of the bottom disk. Servo data is written on the outer recording area of this disk.

This data is used as a control signal for the actuator; that is, it is used as a track crossing signal for positioning or as a track following signal.

The heads are in contact with the disk surfaces during start and stop (C.S.S) at a fixed position called the landing zone. This zone is inside of the recording zone area. A magnet is used to pull or fix the actuator at this position. If no current is applied to the moving

coil, the heads are fixed at the landing zone to prevent C.S.S. in the recording zones.

Once the disks attain the required rotational speed, an initial seek instruction is issued. Current then flows in the coil and the heads are released from the landing zone and moved to the recording zones.

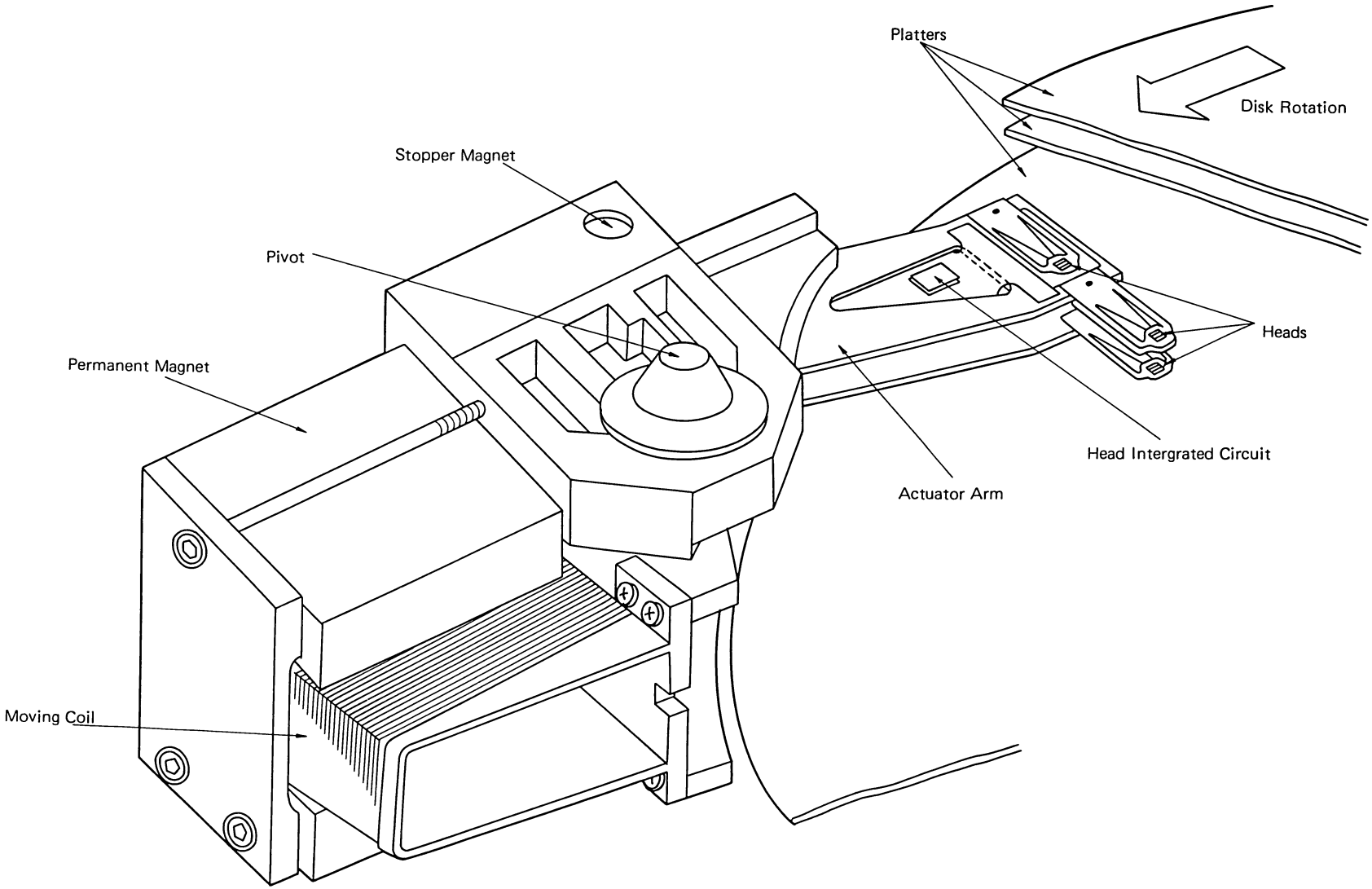


Figure 4-5 Actuator Arm Assembly

(5) Actuator Lock and Spindle Lock

When the disks are stopped, the heads are in contact with the disks. The spindle and actuator are fixed with both the spindle lock and actuator lock for disk and head protection during maintenance, replacement, and transportation of the DE.

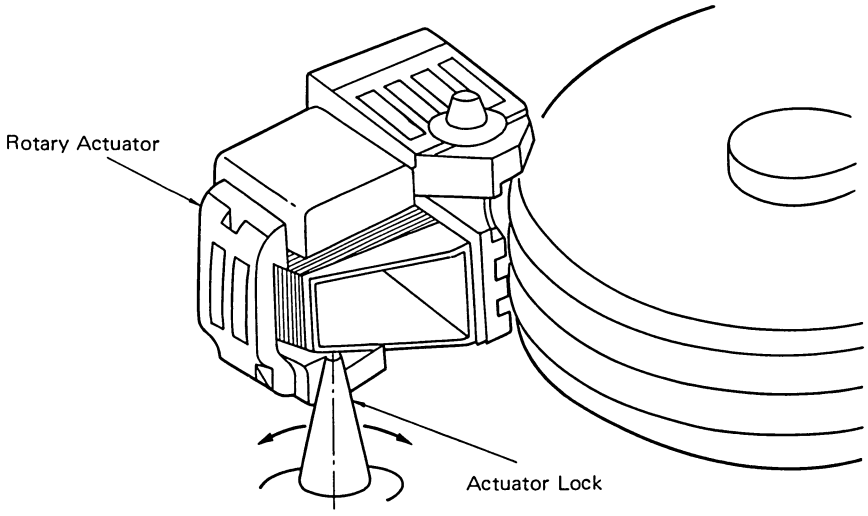


Figure 4-6 Actuator Lock

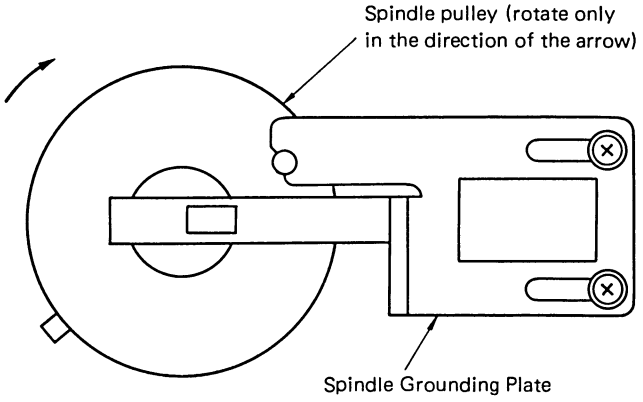


Figure 4-7 Spindle Lock

(6) Air Circulation in DE

As the CSS head used in this disk unit has a very low floating distance (approximately 0.45 μm), head crashes may be caused by microscopic foreign particles. To keep the inside of the DE clean, this enclosure is completely sealed and clean air is supplied through two filters. One filter is used for external air intake, while another filter is used as a re-circulation filter to keep the air inside the DE clean.

The breather filter is used for the following purposes:

(a) **Prevention of negative pressure in the vicinity of the spindle when the disks begin to rotate.**

(b) Prevention of dust intake when the air in the DE contracts due to a temperature difference between the DE and its environment.

The re-circulation filter, attached to the closed loop duct in the DE, is used to keep the air free of foreign particules. When a pressure difference is caused in the DE by the rotation of the spindle, the air in the DE circulates through the closed loop. Because it continually passes through this filter, the air is always kept clean.

These two filters can remove 99.97% of the dust particles (0.3 μm min.).

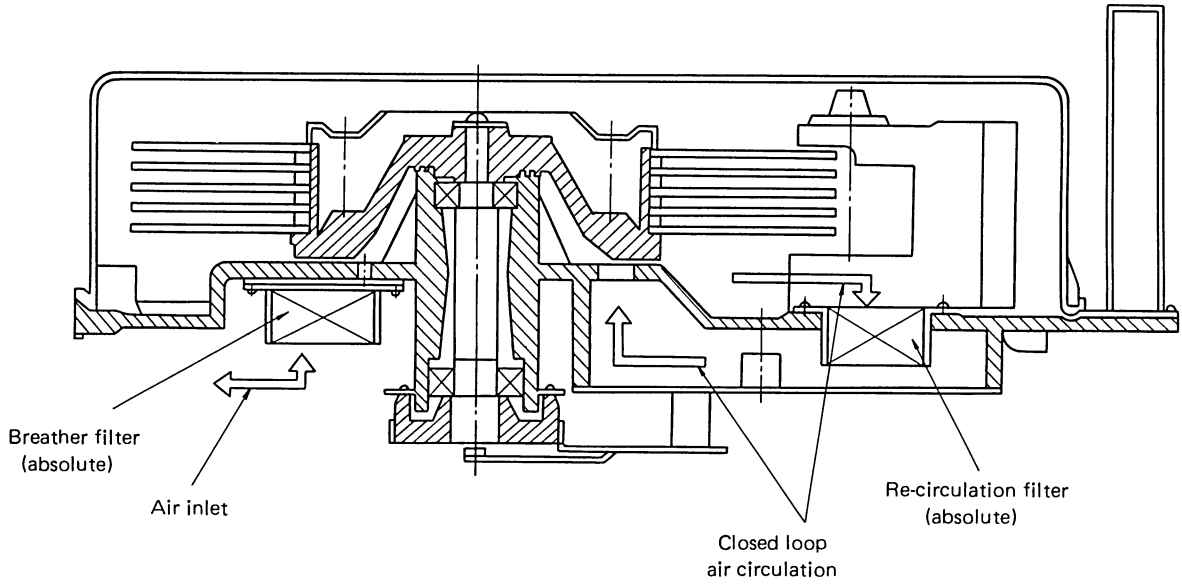


Figure 4-8 Air Circulation in DE

(7) Sub-frame

The sub-frame is supported by four vibration isolating rubber supports (three rubber supports for the vertical type). The disk enclosure is mounted on this sub-frame with three bolts and nuts. The DE can be easily replaced by removing these three nuts.

The DE is insulated from the sub-frame to prevent any influence from noise and vibration.

The sub-frame contains a duct to supply air from the cooling blower to the R/W PCB and the control PCBs.

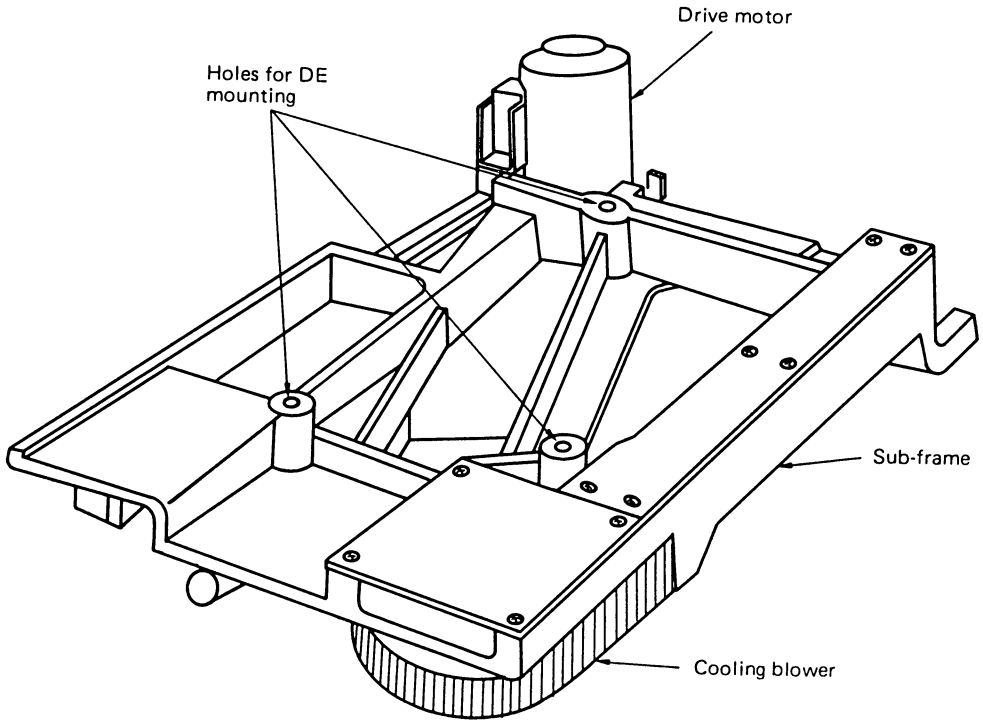


Figure 4-9 Sub-frame

(8) Cooling

A cooling blower provides air to cool the printed circuit boards and motor. Cool air is always supplied from the front to the inside by this blower.

The air is sent through the duct in the subframe and divided into two channels. One cools the read/write printed-circuit board, and the other cools the printed-circuit boards in the chassis, and then the motor.

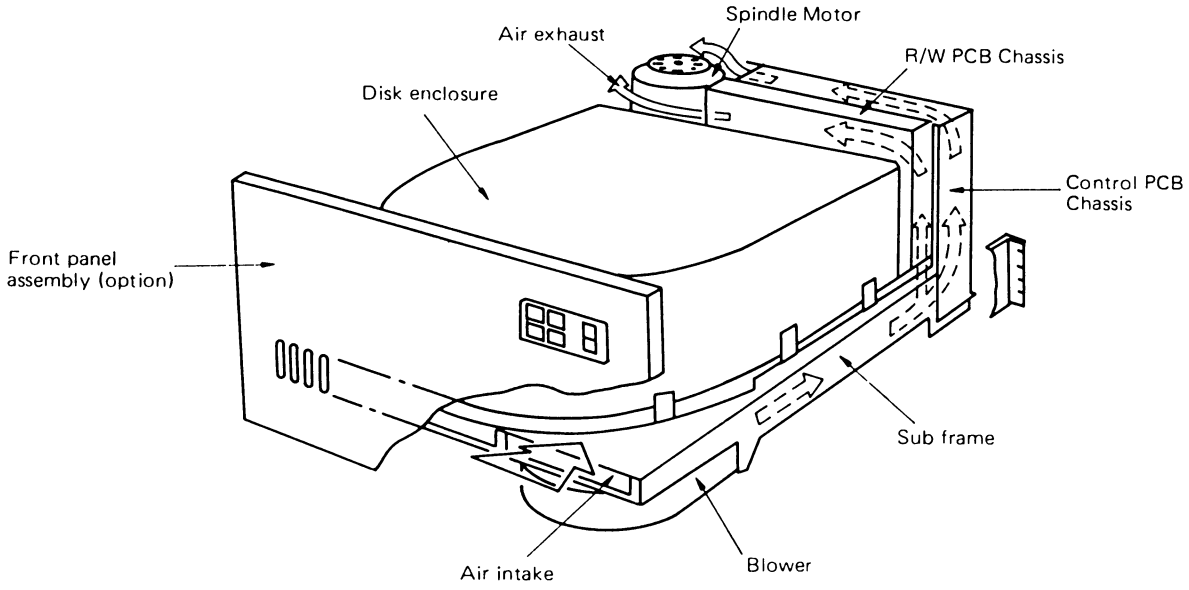


Figure 4-10 Cooling

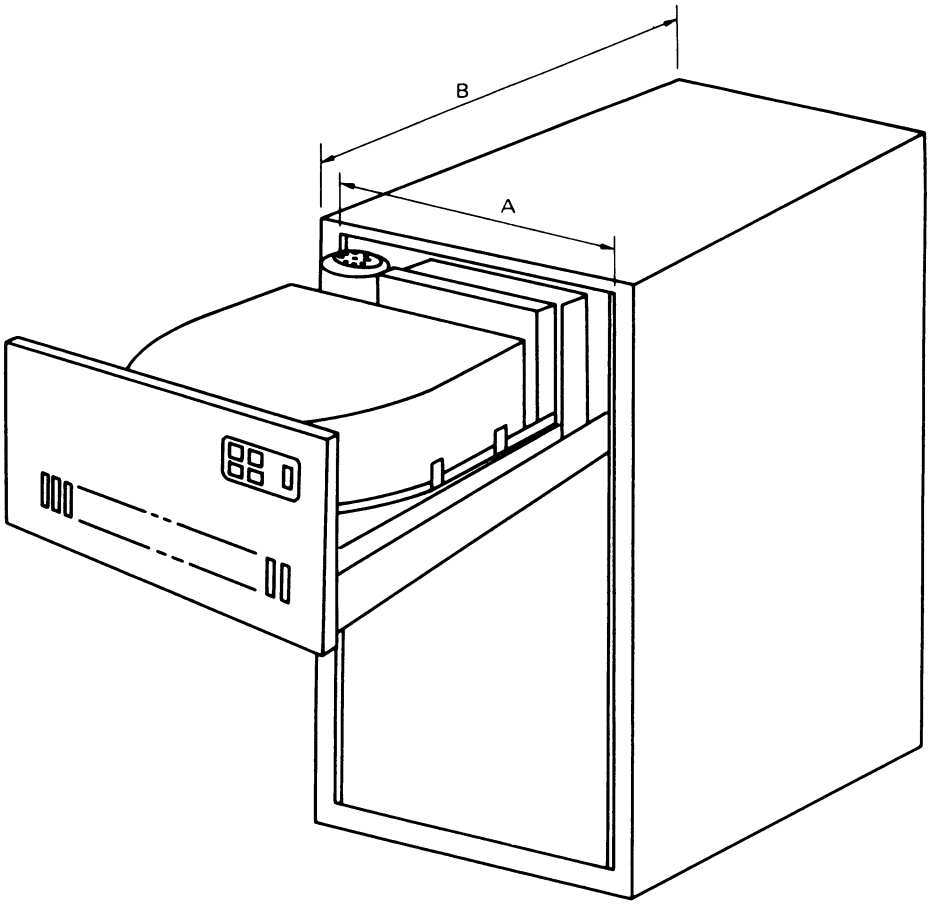
5. INSTALLATION

5.1 Mounting

5.1.1 Rack Mounting

The M2298 may be mounted in a 19-inch rack or built into a system cabinet.

The respective mounting methods are illustrated in Figure 5-1 and Figure 5-2.

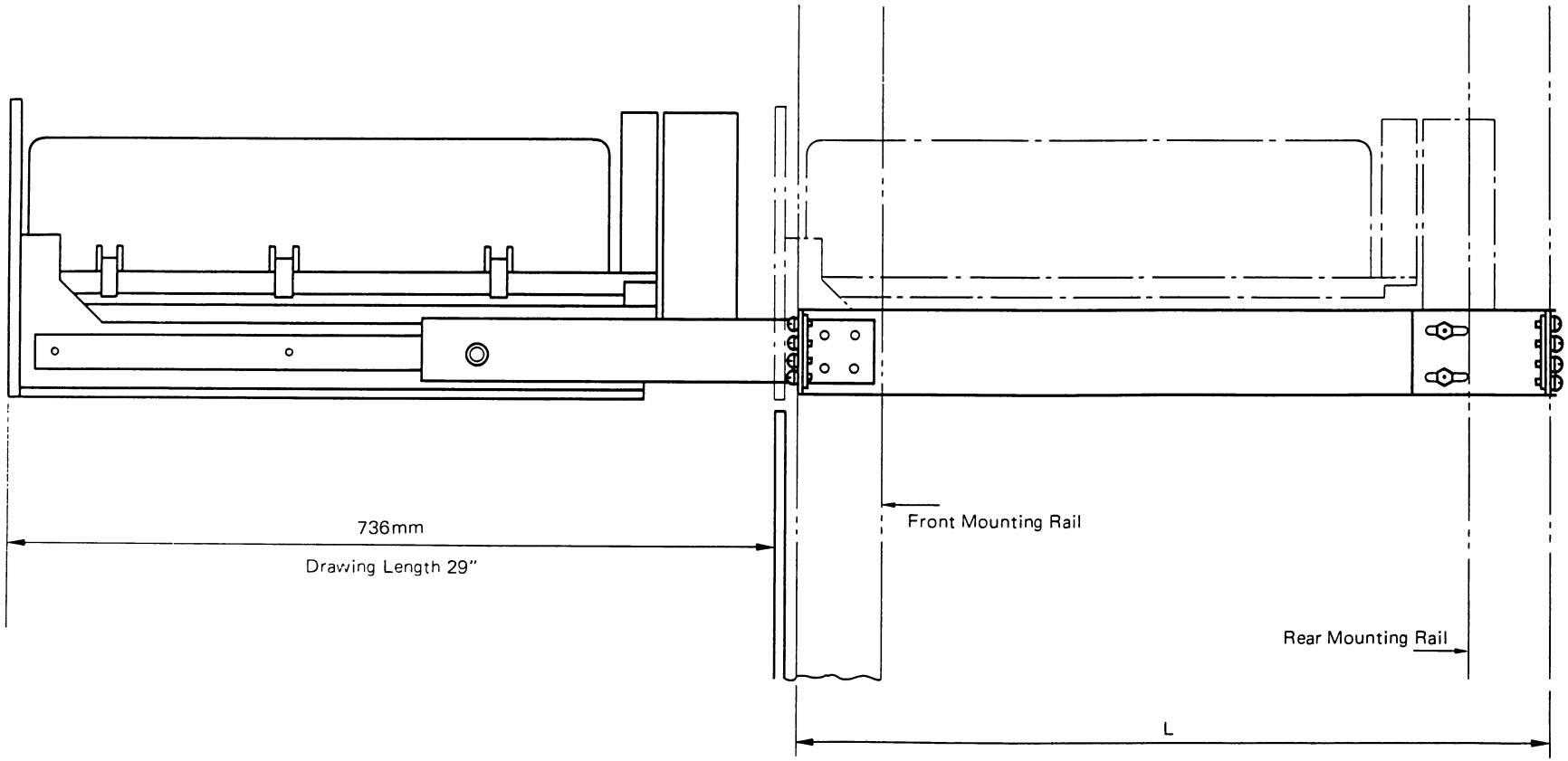


Dimension A Standard Rack: Inside 450mm (17.72")
Outside 482.6 mm (19")

Dimension B USA Standard : 762 mm (30")

European Standard: 751 mm

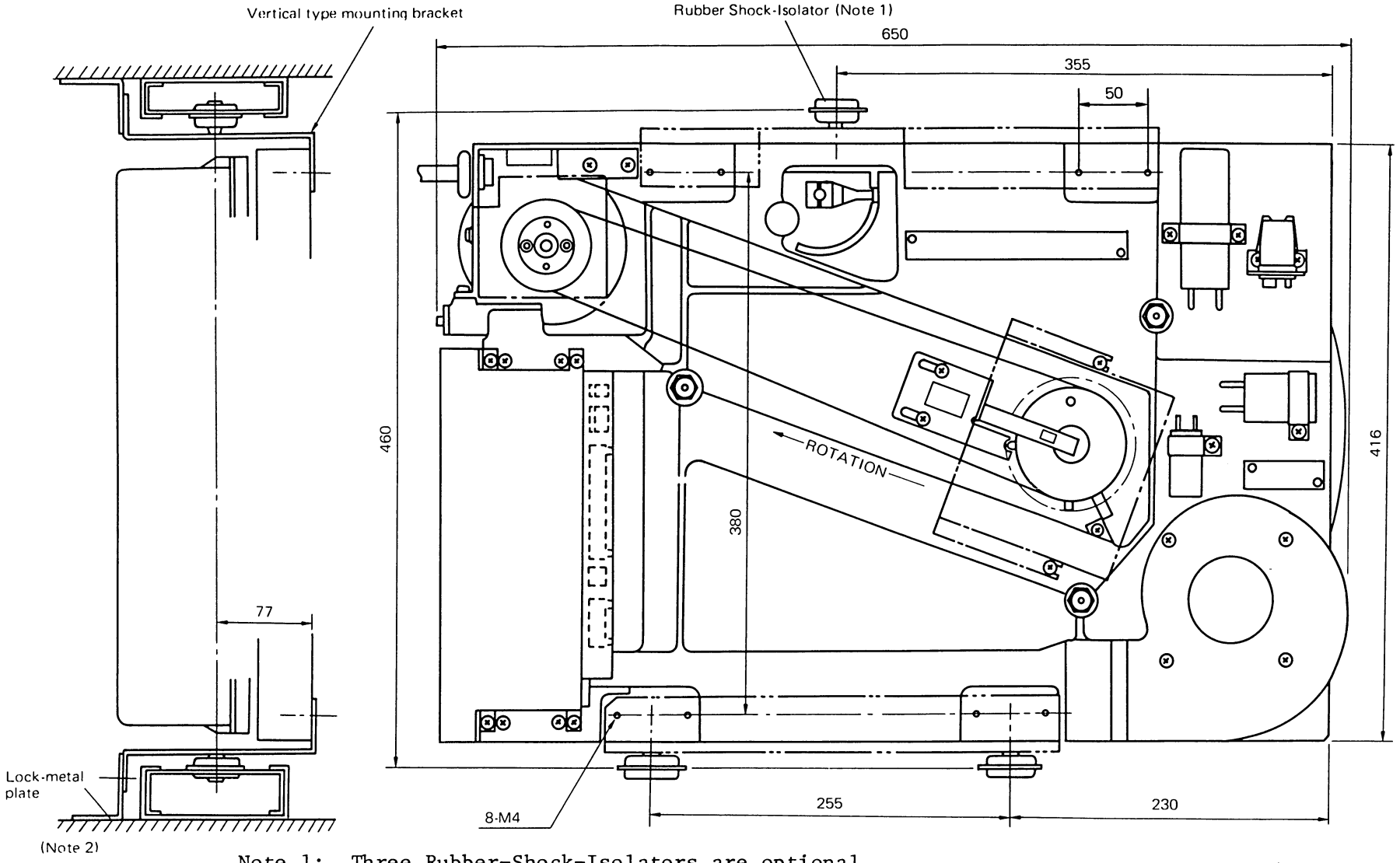
Figure 5-1 19" Rack Mount Installation



Operator Panel and Slide Rail Option

	B03B-4540-E353A/E354A
Slide Guide Length :	24"
Drawing Length :	29"
Mounting Length (L) :	24" to 30"

Figure 5-2 19" Rack Mount Draw Out View



Note 1: Three Rubber-Shock-Isolators are optional.

Note 2: The Unit must be locked only when it is to be shipped.

(Unit: mm)

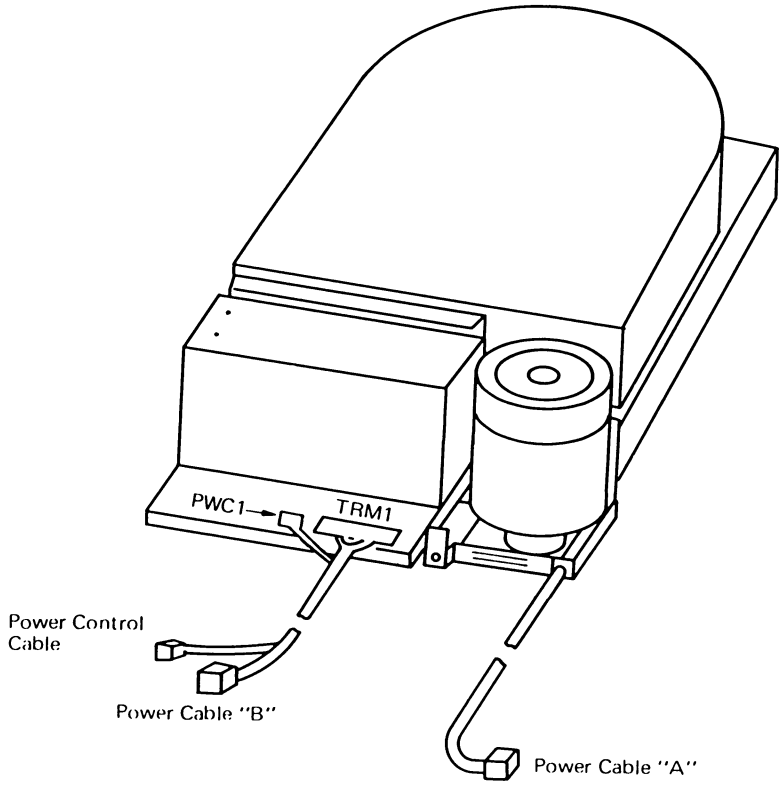
Figure 5-3 An Example of Vertical Mount Installation

5.2 Cabling

5.2.1 Power Cable

The power cable consists of an AC power supply "A" cable and a DC power supply "B" cable. The "A" cable supplies power to drive the spindle motor and brake, and blower motor, and the "B" cable supplies DC operating power to the logic and analog circuits.

The power cable connections are given in Figure 5-4 and Table 5-1.



(This figure is referred to when connectors are used.)

Figure 5-4 Power Cables

Table 5-1 Power Cables

Cable	Pin Assignment	Wire Mark	Voltage	AWG No.	Wire Color	Connector
"A"	1	AC-A1	AC Input A1	AWG 18	White/Orange	Plug (AMP) 1-480708-0
	3	AC-A2	AC Input A2	AWG 18	White	
	4	*AC-B1	AC Input B1	AWG 18	White/Orange	
	6	*AC-B2	AC Input B2	AWG 18	White	
	5	FG	FG	AWG 18	Green	
	7	ALM	ALARM	AWG 20	Grey	Contact (AMP) 350550-3
	9	ALM	ALARM	AWG 20	Yellow	
	10	+24V	DC +24V	AWG 16	Red	
	12	0V	0V	AWG 16	Black	
"B"	5	+5V	DC +5V	AWG 14	Red	Plug (AMP) 1-480710-0
	6	0V	0V	AWG 14	Black	
	1	+12V	DC +12V	AWG 18	Red	Contact (AMP) 350550-7(1.2.7.8P) 350551-3(5.6P)
	2	0V	0V	AWG 16	Black	
	7	-12V	DC -12V	AWG 18	Blue	
	8	0V	0V	AWG 16	Black	

*Note: When AC input is 220V/240V, AC-B input should be nominal AC 100V.

Table 5-2 Power Control Connector (CN1)

Pin Assignment	Signal	Wire Color	AWG No.	Connector
1	*RDY1	Yellow	AWG 20	
2	*RDY2	Yellow	AWG 20	Plug (AMP) 1-480706-0
3	*RDY3	Yellow	AWG 20	
4	Pick In	Black	AWG 20	
5	Hold	Black	AWG 20	
6	Pick Out	Black	AWG 20	Contact (AMP) 350550-7
7	0V	Yellow	AWG 20	
8	0V	Yellow	AWG 20	

The power cable "A" and "B" are furnished with the unit.

"A" cable is for AC power and "B" cable is for DC power with the power control connector.

Table 5-3 Power Cable List

Description	Specification
"A" Power Cable with connector	B660-1055-T017A
"B" Power Cable with connector	B660-1055-T018A

The cable length shall be specified in 1, 2, 3 and 4 m lengths.

Example: B660-1055- 017A#L3R003

3.00×10^3 mm = 3.0 m

5.2.2 Interface Cabling

Interface cables include cable "A" (60P) for control signals and cable "B" (26P) for data signals.

Cables are connected the system in the star connection mode or the daisy-chain mode as shown in Figure 5-5, and 5-6.

For the star connection mode, the line termination for cable "A" is necessary for every unit.

For the daisy-chain mode only the last unit requires a Line Terminator.

The grounding wire of the Line Terminator must be connected to a signal ground TRM1-2.

In the case of dual-port operation, the interface cables from the channel-A and B controllers are also connected the system in the star connection mode or the daisy-chain mode as shown in Figures 5-7 and 5-8.

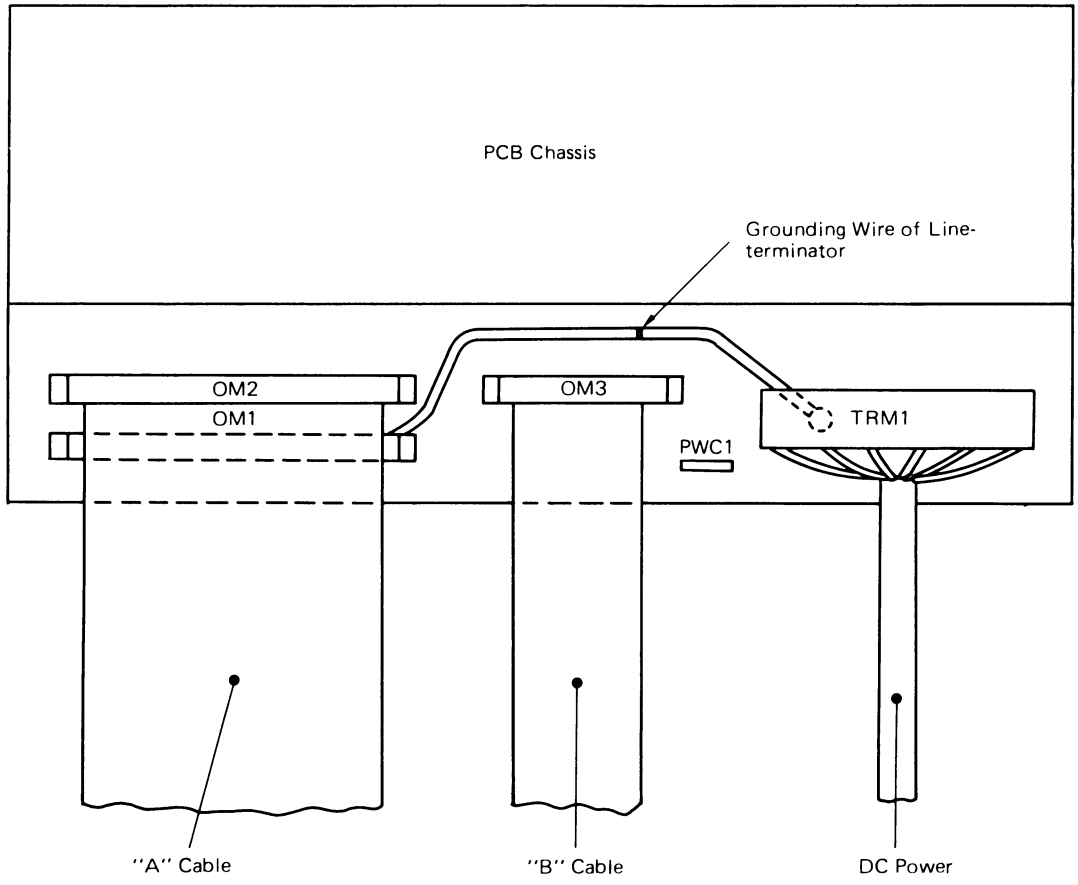
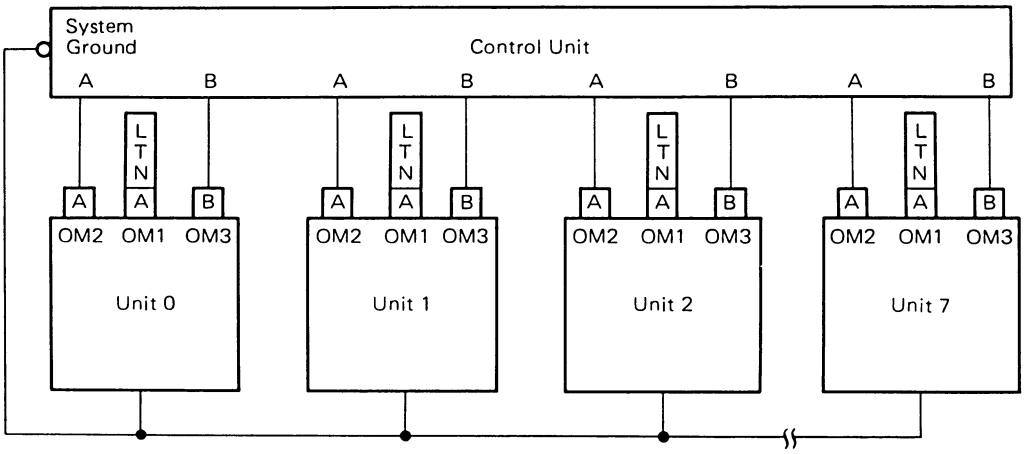
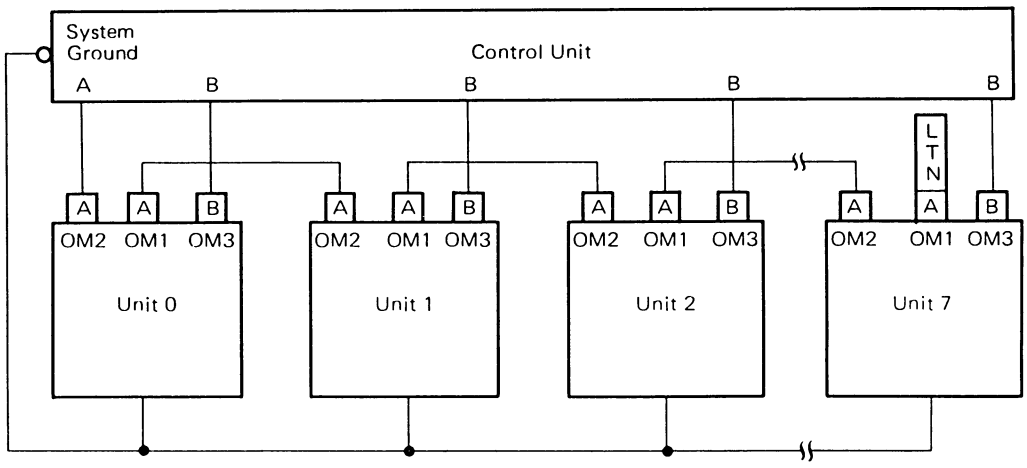


Figure 5-5 Interface Cabling (Single Port)



Star-Cabled Configuration



Daisy-Chain-Cabled Configuration

Figure 5-6 System Interface Cabling (Single Port)

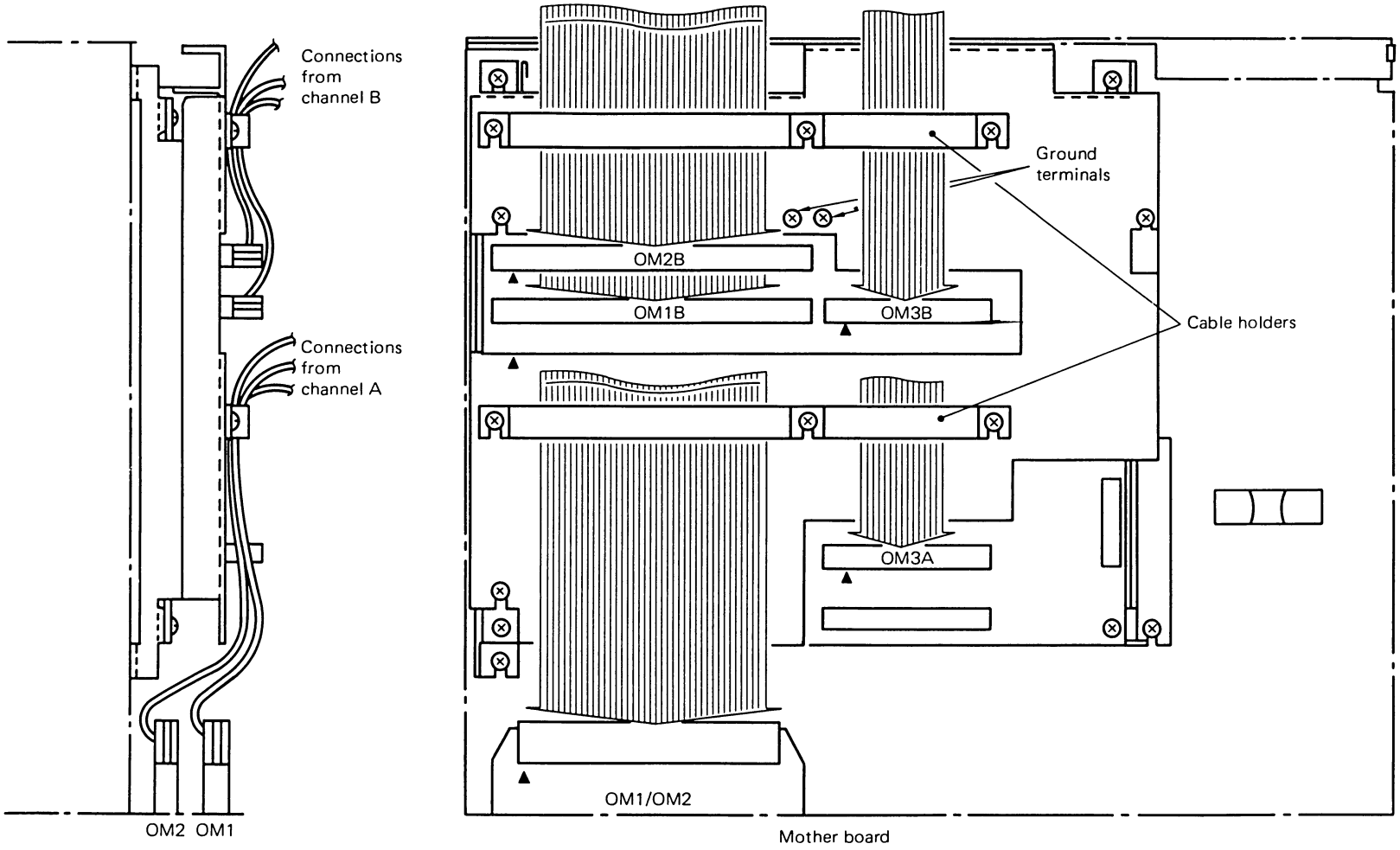
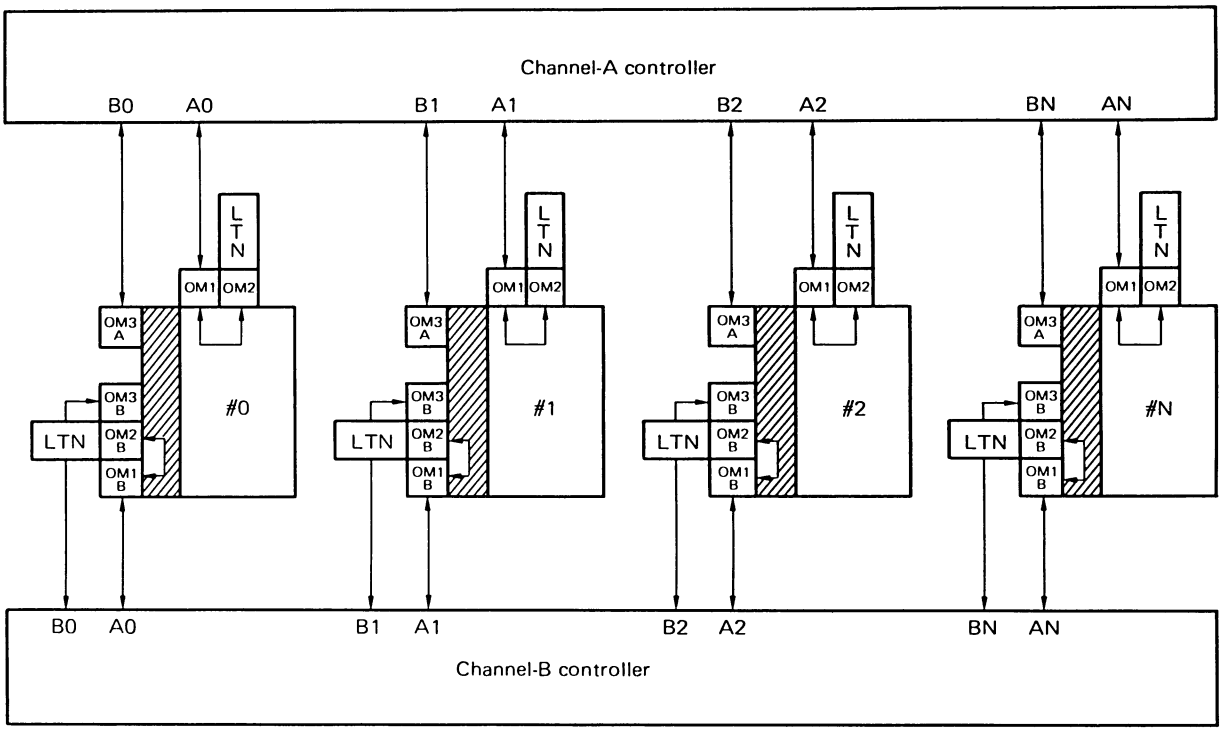
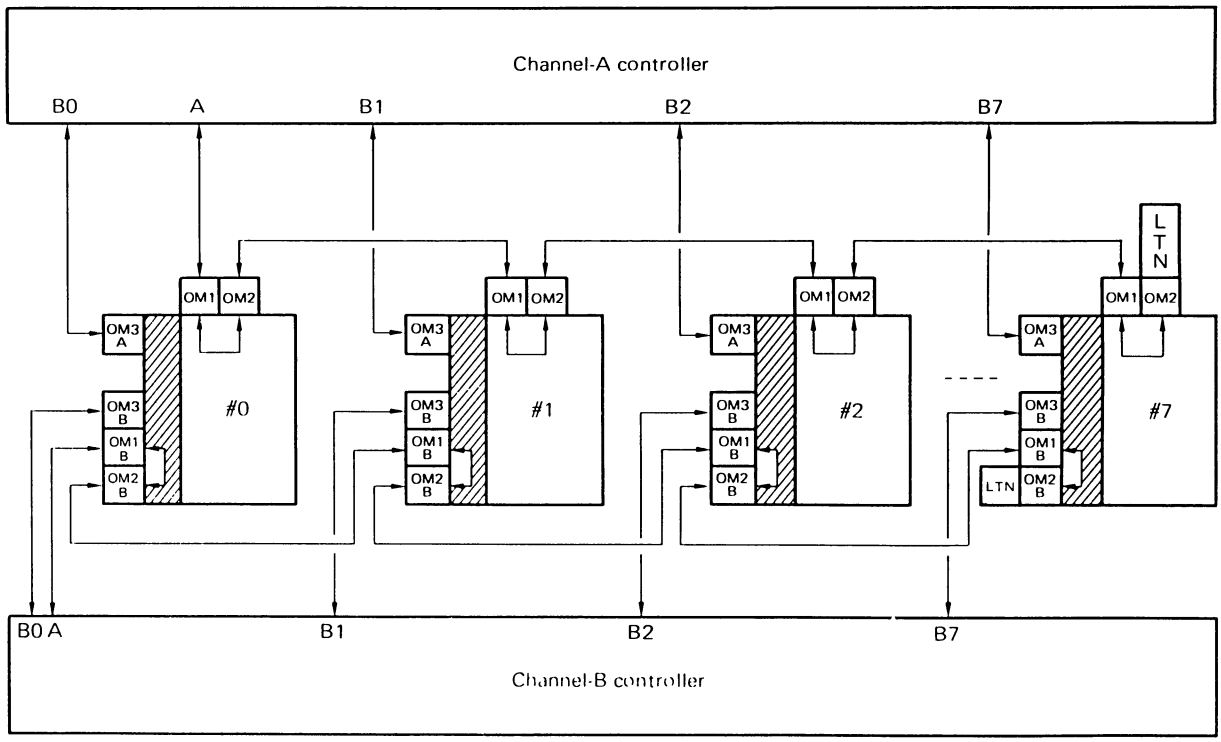


Figure 5-7 Interface Cabling (Dual Port)



(a) Star Connection

Note: Hatched areas denote dual port options.



(b) Daisy Chain

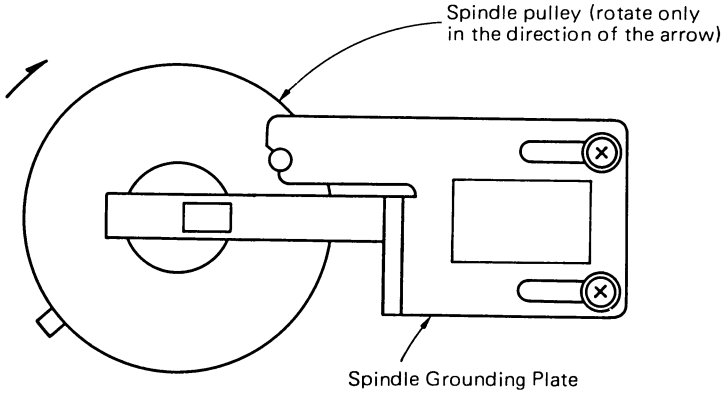
Figure 5-8 System Interface Cabling (Dual Port)

5.3 Unlock, Adjustment and Mode Setting

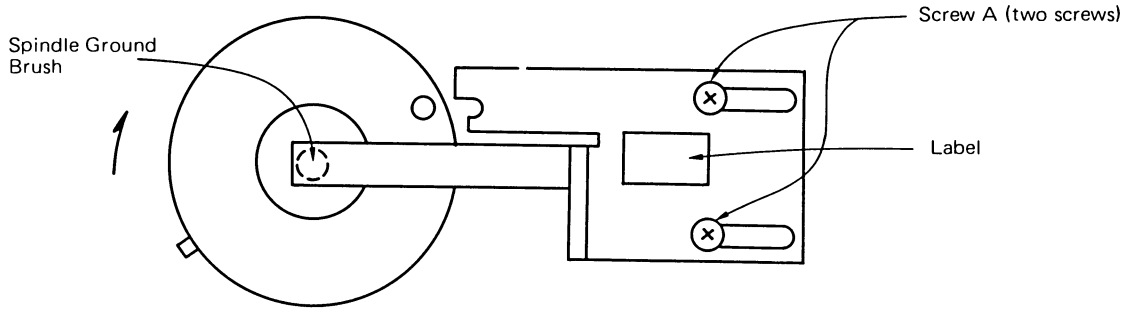
5.3.1 Unlocking Spindle

The spindle is locked with a spindle lock so that it cannot rotate during shipment. The spindle lock is located at the bottom of the spindle, and locks the spindle pulley. When installing the unit, the spindle lock must be released by loosening screws A (two screws) shown in Figure 5-9.

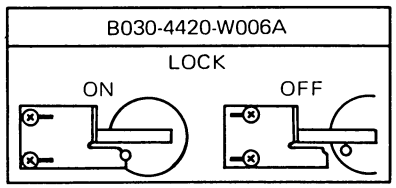
After unlocking, the spindle ground brush must be adjusted at center.



(a) Spindle Locked



(b) Spindle Released



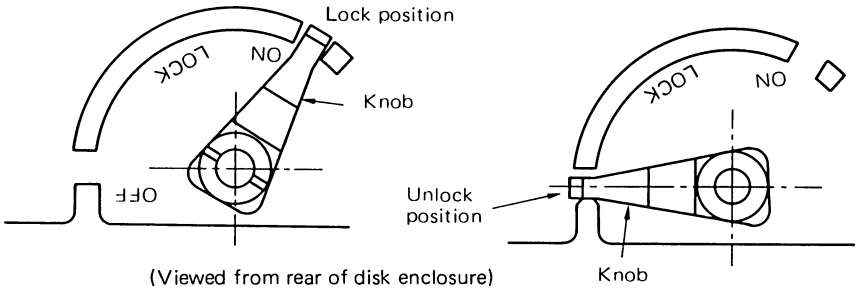
(c) Label

Figure 5-9 Releasing Spindle Lock

5.3.2 Unlocking the Actuator

If the actuator rotates when the disk is stopped, the heads and disks may be damaged. Therefore, the actuator is locked during shipment.

After installing the unit, the actuator must be unlocked by rotating the stopper. The stopper can be unlocked by turning the knob at the bottom rear of the disk enclosure through the hole in the sub-frame.



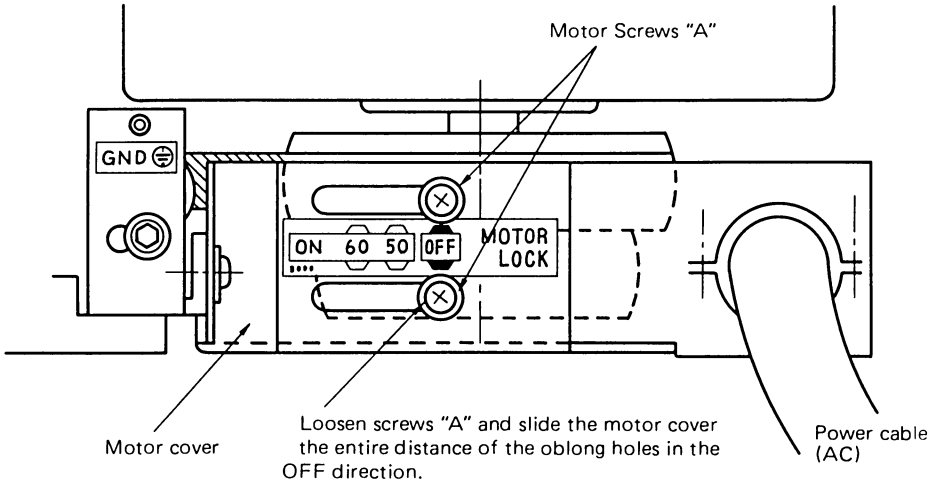
(a) Actuator locked (b) Actuator unlocked

Figure 5-10 Actuator Lock

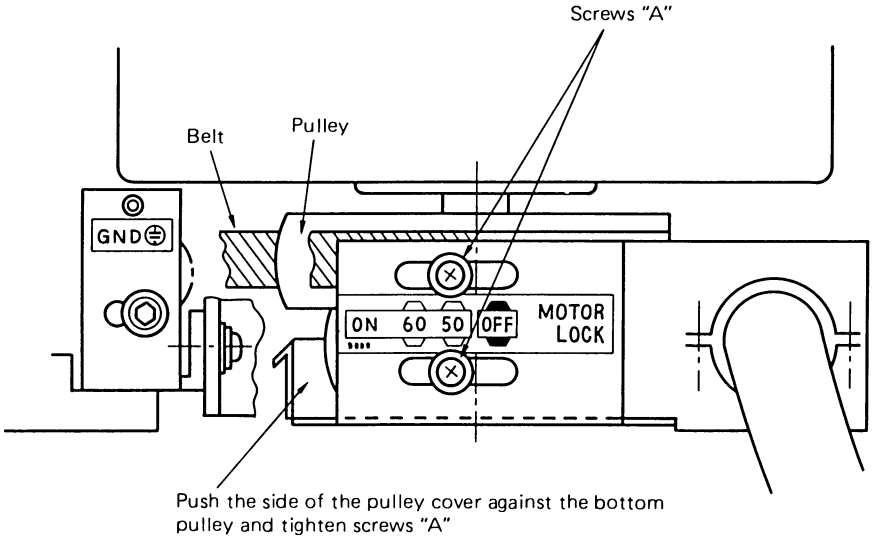
5.3.3 Unlocking the Motor

The motor must be locked during shipment to prevent unhooking the belt by vibration of the spindle. The motor is locked by pushing the motor pulley cover (covering the motor pulley section) against the motor pulley. The motor is unlocked by loosening the two screws "A" holding the motor cover to the rear of the unit and sliding the pulley cover fully to the Left (unlock) position. Then secure screws "A". (Figure 5-11)

(a) Motor unlocked



(b) Motor locked

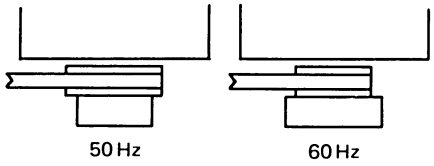


Note: Lock-on position is different according to power line frequency.

Figure 5-11 Motor lock and release

5.3.4 50Hz/60Hz Exchange

Check the power line frequency being 50Hz or 60Hz, and confirm that the correct motor pulley is being used. The correct pulley diameter and belt position (50Hz/60Hz) are given on a label attached to the motor pulley cover (bottom side). The large diameter pulley is for 50Hz and the small diameter pulley is for 60Hz. (The label is illustrated in Figure 5-12.) When the power line frequency and the pulley mounted in the unit are different, the motor pulley must be changed and the belt tension must be adjusted to the correct line on the tension mark.



Tension Mark

50H 60H	Horizontal
50V 60V	Vertical

Figure 5-12 Frequency and Pulley Position (Label)

5.4 Mode Select Setting

When the FDU M2298 is installed in the system, the customer must set the following modes according to system requirements, that is, Disk Logical Unit Number, Tag 4/5 Enable and Sector Mode on KGEM PCB assembly and Sector Counting on VOIM PCB assembly.

5.4.1 Disk Addressing

Disk Logical Unit Number 0 to 7 is selectable on SW1 at location J2 on the KGEM PCB assembly. Set the desired disk address with three keys on SW1 using binary code as shown in Table 5-4 and Figure 5-13.

Table 5-4 Disk Addressing

Disk Address	Key 1	Key 2	Key 3
	2^0	2^1	2^2
0	OFF	OFF	OFF
1	ON	OFF	OFF
2	OFF	ON	OFF
3	ON	ON	OFF
4	OFF	OFF	ON
5	ON	OFF	ON
6	OFF	ON	ON
7	ON	ON	ON

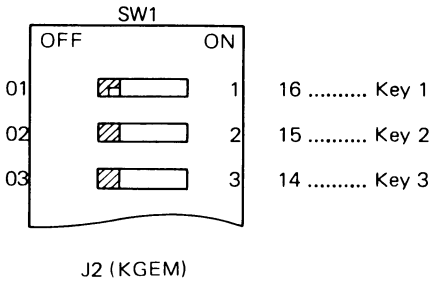


Figure 5-13 Disk Addressing

5.4.2 Sector Mode

The customer can only select Hard Sector mode (1 to 128 sectors) using Key 7 on SW2 at location P3 on the KGEM PCB assembly according to Table 5-5 and Figure 5-14.

For Hard Sector, the customer must set the number of sectors per disk revolution as described in 5.4.3.

Table 5-5 Sector Mode

Sector Mode	Key 7
Hard Sector	OFF
	Reserved

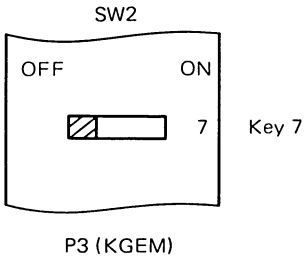


Figure 5-14 Sector Mode

5.4.3 Tag 4/5 Enable

FDU M2298 provides optional Tag 4 and Tag 5 functions, however, the customer may disable or enable these functions using Key 8 on SW2 at location P3 on the KGEM PCB assembly. Disabling the Tag 4/5 functions inhibits the receivers of Tag 4 and Tag 5 on the interface.

Table 5-6 Tag 4/5 Enable

Tag 4/5	Key 8
Disable	OFF
Enable	ON

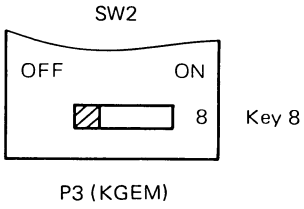


Figure 5-15 Tag 4/5 Enable

5.4.4 Sector Counting

Sector count configuration switches, SW1 and SW2, are located at R7 and P7 respectively on the VOIM PCB assembly. Each key of SW1 and SW2 represents the binary powers of the 2 Byte Clock as shown in Table 5-7.

Table 5-7 Sector Counting Keys

SW1 Key No.	Value	SW2 Key No.	Value
1	2	1	256
2	4	2	512
3	8	3	1,024
4	16	4	2,048
5	32	5	4,096
6	64	6	8,192
7	128	7	16,384

SW1 and SW2 keys must be set according to the even number of bytes per sector. Knowing that the number of bytes possible on a track equals 40,960 any sectoring requirement from 1 to 128 sectors per track can be configured using the following formulas:

(1) Calculation based on Sectors/Track

Example : 9 Sectors/Track

1) $\frac{40,960}{\text{Number of sectors}} = \text{Number of Bytes per sector}$ $\qquad \frac{40,960}{9} = 4,551$

2) If the above calculation results in a remainder, truncate the remainder and add one or two to the integer portion of "number of bytes per sector" to get an even number. $\qquad 4,551 + 1 = 4,552$

3) Configure SW1 and SW2 to "number of bytes per sector" less two to allow for the Sector Counter Reset Clock. $\qquad 4,552 - 2 = 4,550$

$$4,550 = 4,096 + 256 + 128 + 64 + 4 + 2$$

Keys must be "ON" : Key # 5 1 (SW2) 7 6 2 1 (SW1)

4) To determine how many bytes (if any) the last sector of each track will be short, multiply "number of bytes per sector" by "number of sectors" and subtract 40,960.

$4552 \times 9 = 40{,}968$

$\underline{40{,}960}$

Last sector short 8 bytes

(2) Calculation based on Bytes/Sector

Example : 584 Bytes/Sector

1) Calculate the value to be set.

= 32,768 - (Byte/Sector) (Particular Value)

= 32,768 - 584

= 32,184

2) Select the keys must be OFF position referring to Table 5-7 after the following calculation.

32,184 = 16,384+8,192+4,096+2,048+1,024+256+128+32+16+8

Keys must be "OFF": 7 6 5 4 3 1 (SW2) 7 5 4 3 (SW1)

3) Calculate the Sectors/Track

$$\text{Sectors/Track} = \frac{\text{Bytes/Track}}{\text{Bytes/Sector}}$$

$$= \frac{40{,}960}{584}$$

$$= 70.137$$

4) If the above calculation results in a remainder, truncate the remainder. The integer portion means actual sectors per track.

Actual Sectors/Track = 70

5) Calculate the number of the last sector (remainder).

Last Sector Length = 40,960-(Bytes/Sector)×(Sectors/Track)

= 40,960-584×70

= 80

The commonly used sector configuration is shown in Table 5-8.

Table 5-8 Commonly Used Sector Configurations

NO SECTORS	S1	S2	BYTE/SECT	LAST SECTOR SHORT
	1 2 3 4 5 6 7	1 2 3 4 5 6 7		
4	1 1 1 1 1 1 1	1 1 1 0 0 1 0	10,240	0
8	1 1 1 1 1 1 1	1 1 0 0 1 0 0	5,120	0
12	0 1 0 1 0 1 0	1 0 1 1 0 0 0	3,414	-16
16	1 1 1 1 1 1 1	1 0 0 1 0 0 0	2,560	0
24	1 0 1 0 1 0 1	0 1 1 0 0 0 0	2,410	-20
32	1 1 1 1 1 1 1	0 0 1 0 0 0 0	1,280	0
64	1 1 1 1 1 1 0	0 1 0 0 0 0 0	640	-240
128	1 1 1 1 1 0 0	1 0 0 0 0 0 0	320	0

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6. OPERATION AND CONTROL

6.1 Operation

6.1.1 Block Diagram

The block diagram of the FDU is shown in Figure 6-1.

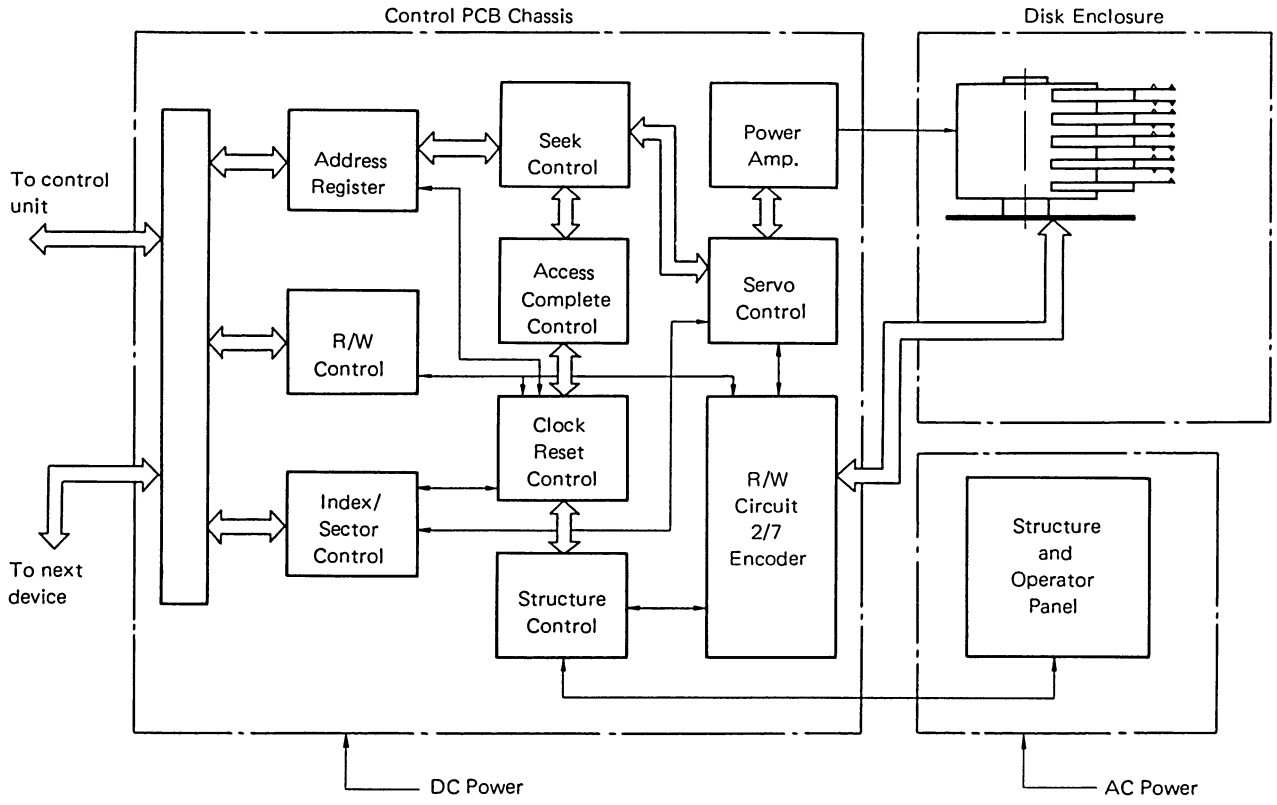

Figure 6-1 Block Diagram

6.1.2 Operation

(1) Positioning

The head address and cylinder address from the control unit are sent to the Head Address Register and Cylinder Address Register. The Binary-coded head address is decoded into decimal and then one head is selected.

The difference between the Present Cylinder Address Register and a Requested Cylinder Address Register is calculated and the direction is specified, causing the heads to be driven to the designated address.

A count of one is subtracted from the difference counter every time the servo head crosses one cylinder.

When the difference counter goes to zero, the servo control is changed to fine positioning. The control unit then receives the completion signal of a normal seek operation.

(2) Write

After confirmation of normal seek operation, the control unit issues a write command to the unit. At the same time, the control issues NRZ Write Data and Write Clock synchronized with the IF Write Clock from the unit. The Write Data is write-compensated and modulated into RLL2, 7 write data and than written at the specified address.

(3) Read

After confirmation of a normal seek operation, the control unit issues Read command to the unit.

The data is recovered from the specified address and demodulated into an NRZ signal, and then the unit issues NRZ Read Data synchronzied with the IF Read Clock.

6.2 Controls and Indicators

6.2.1 Operator Panel (Option)

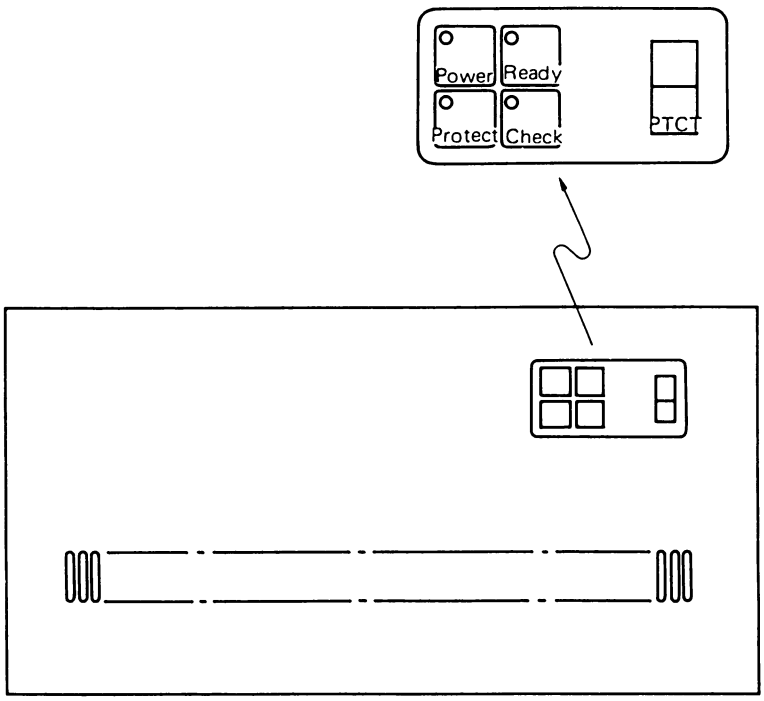

Figure 6-2 Operator Panel

(1) Power Indicator: Red

Indicates power-in status.

(2) Ready Indicator: Red

Indicates the initial seek has been performed or that seek or RTZ operation has been terminated.

(3) Check Indicator: Red

Indicates any fault condition.

(4) Protect Indicator: Red

Indicates a write-protected status.

(5) PTCT (Protect) Switch: White

Inhibits the write operation.

(6) Check Clear Switch: Gray

Clears the device check flip-flop.

6.2.2 PCB Chassis

The unit contains a PCB chassis with Maintenance Aid Display (LED's), a Device Check Clear switch and File-protect switch as shown in Figure 6-3.

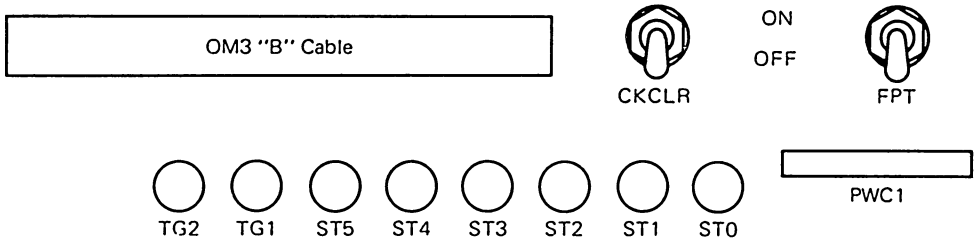

Figure 6-3 Maintenance Aid Display and Switches

(1) CKCLR (Check Clear) switch: (momentary)

Clears a Device Check status.

(2) FPT (File-protect) switch

Inhibits the write operation. When an optional operator panel is installed on the unit, this switch should be in the OFF position.

(3) TG1, 2 (Status Tag 1, 2) LED's: Red

Indicates four basic disk conditions in binary coded decimal, which are Not-Ready status, Device Check status, Unit status and Seek Check status.

(4) ST0 to ST5 (Status 0 to 5) LED's: Red

Indicates six status conditions, which are displayed for each Tag 1 and 2 combination as shown in Table 6-1.

Table 6-1 Maintenance Aid Display Conditions

TG	Tag Decode 0	Tag Decode 1	Tag Decode 2	Tag Decode 3
ST	Not Ready	Device Check	Unit Status	Seek Check
0	Power Ready	Control Check 1	Unit Selected	RTZ or Seek Timeout
1	Channel Ready	Control Check 2	Fixed Sector Mode	Seek Guard Band
2	Speed OK	Read/Write Check 1	On Cylinder	Linear Mode Guard Band
3	Start 1	Read/Write Check 2	File Protected	RTZ Outer Guard Band
4	Start 2	Read/Write Check 3	Busy	Over Track Crossing Pulse
5	Initial Seek Timeout	Read/Write Check 4	Access Head Selected	Illegal Cylinder

6.2.3 Dual Port Option

The Dual Port Option has the operational switches and LEDs as shown in Figure 6-4. It is operated and observed from top side.

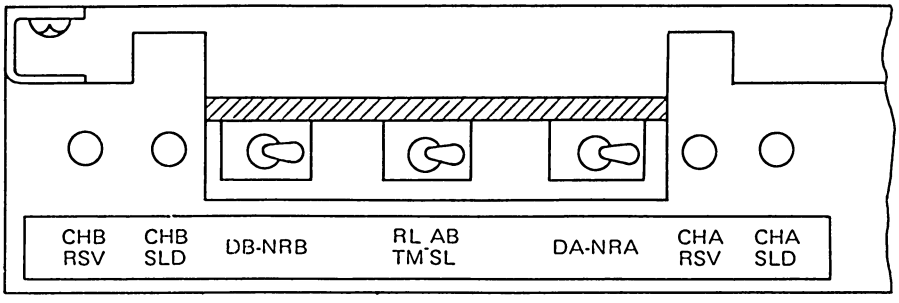

Figure 6-4 Switches and Indicators of Dual Port Option

(1) CHASLD LED (green)

Indicates that this unit is selected by the channel-A controller.

(2) CHARSV LED (orange)

Indicates that this unit is reserved by the channel-A controller.

(3) CHBSLD LED (green)

Indicates that this unit is selected by the channel-B controller.

(4) CHBRSV LED (orange)

Indicates that this unit is reserved by the channel-B controller.

(5) DA-NRA switch

DA (Disable A) : Selected to disconnect the unit from the channel-A controller and disable it to send and receive all interface signals.

NRA (Normal) : Selected to connect the unit to the channel-A controller and enable it to send and receive interface signals.

(6) DB-NRB switch

DB (Disable B) : Selected to disconnect the unit from the channel-B controller and disable it to send and receive all interface signals.

NRB (Normal B) : Selected to connect the unit to the channel-B controller and enable it to send and receive interface signals.

(7) RLTM-ABSL switch

RLTM side : If this is switched to RLTM (Release Timer) side, the reserved condition is released from the unit side.

ABSL side : If this is switched to ABSL (Absolute) side, the reserved condition is released from the controller side.

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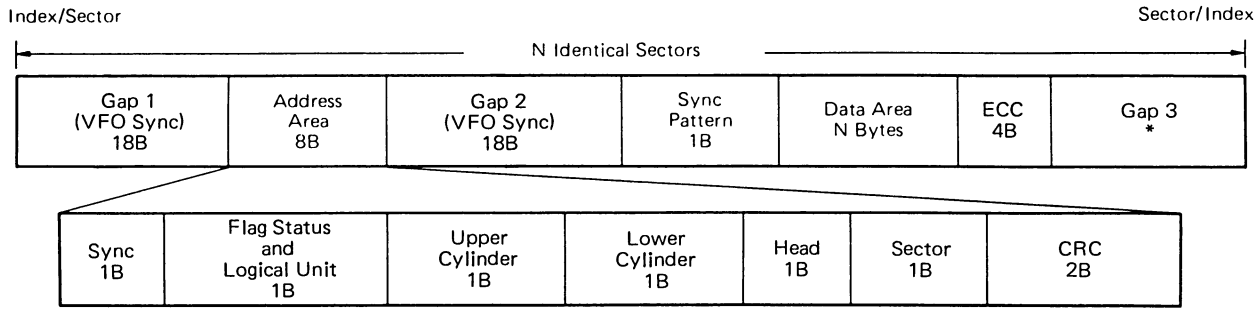
7. FORMAT

7.1 Fixed Sector Format



Example : 128 Sectors/Track

$$\text{Data Area} = \frac{\text{Total Bytes/Track}}{\text{Sector/Track}} - \left(\begin{matrix}\text{Gap} \\ \text{loss}\end{matrix} + \begin{matrix}\text{Check} \\ \text{Bytes}\end{matrix} \right)$$

$$= \frac{40{,}960}{128} - (49 + \text{GAP3}) = 256 \text{ Bytes}$$

In Case of 256 bytes data length, GAP3 is 15 Bytes.

$$\text{Track Efficiency} = \frac{256 \times 128}{40{,}960} \times 100 = 80\%$$

Notes: 1) This format is an example only and may be structured to suit individual requirements.

2) The Sync Byte Sent on the B-Cable will be recommended with a "19" (Hex) pattern.

3) Fixed sectors per track may be any number from 1 through 128 and can be selected by setting the configurator switches on the PCB (VOIM). Refer to 5.4.4.

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8. OPTION

The following items are not standard and must be purchased separately if desired:

Table 8-1 Options List

	Option	Specification	Remarks
1	Power Supply Unit	B14L-5105-0179A #A1	AC100V/115V
2	Power Supply Unit	B14L-5105-0180A #A1	AC220V/240V
3	Operator Panel	B03B-4540-E352A	19" rack mount type without 24" slide rail
4	Operator Panel and Slide Rail	B03B-4540-E353A	19" rack mount type with 24" slide rail
5	Operator Panel and Slide Rail	B03B-4540-E354A	Same above without Front Panel, Operator Switch and Cable
6	Slide Rail Kit	B030-4540-V450A	Kit of slide rail, brackets, nut bars and screws
7	Dual Port	B03B-4540-E901A	Dual Port PCB assembly and mounting plates
8	Rubber Shock Mount	B30L-1920 -0002A	Build-in vertical mount shock rubber
9	Line Terminator	B16B-4870-0010A	TCAM
10	Interface Cable A	B660-1065-T006A	60-position flat cable
11	Interface Cable B	B660-1065-T008A	26-position flat cable

Note 1) All options are commonly used with model M228X and M2294.

2) A Line Terminator TCAM is commonly used with M2351A.

8.1 Power Supply Unit (B14L-5015-0179A#A1)

The Power Supply Unit provides the all AC/DC powers required by M2298 including Dual Port option under AC100V/115V, and also provides the remote power control function for the Spindle Motor and +24VDC, controlled by enabling Pick/Hold signals from the control unit.

If line voltage is changed between AC100V and AC115V, the tap selection is required within the Power Supply Unit. The weight is approximately 12 kg.

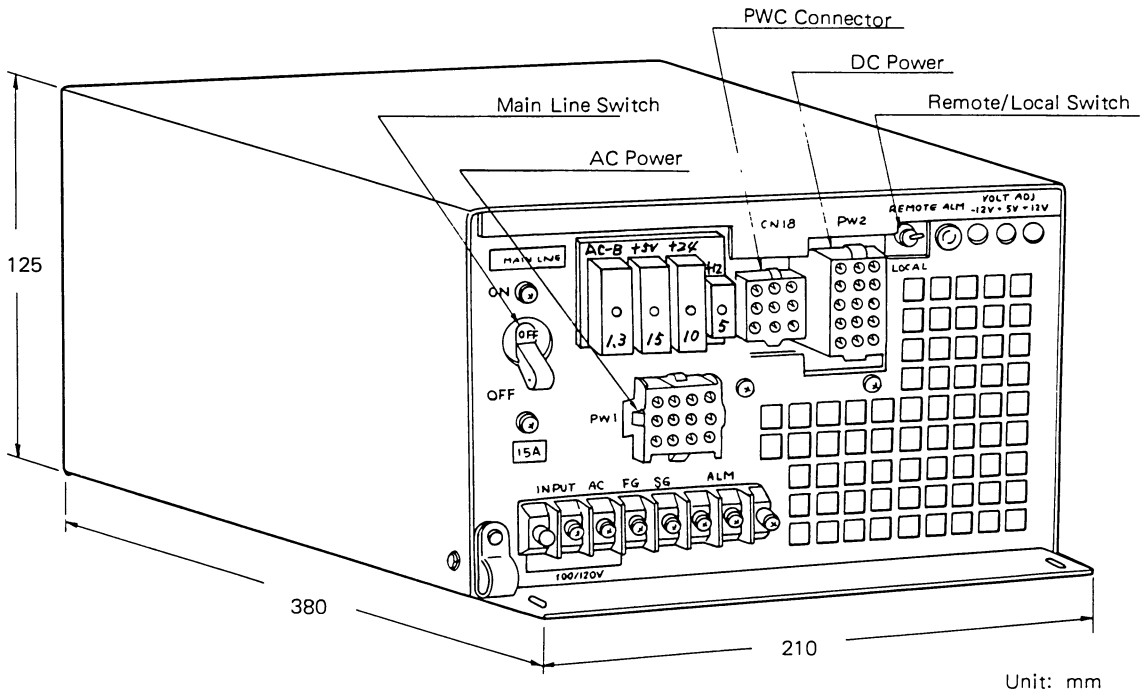


Figure 8-1 Power Supply Unit (B14L-5105-0179A#A1)

8.2 Power Supply Unit (B14L-5105-0180A#A1)

The Power Supply unit provides the all AC/DC powers required by M2298 including Dual Port option under AC220V/240V, and also provides the remote control function for the Spindle Motor and +24VDC, controlled by enabling Pick/Hold signals from the control unit.

If line voltage is changed between AC220V and AC240V, the tap selection is required within the Power Supply Unit. The weight is approximately 12.5 kg.

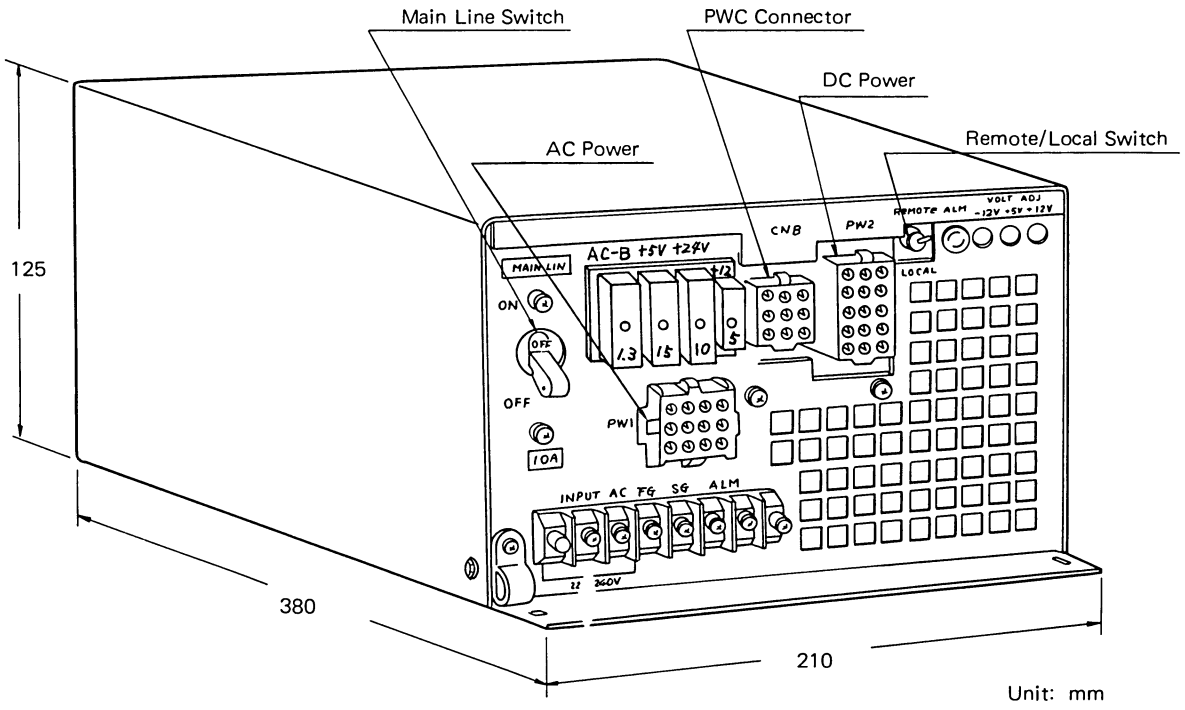


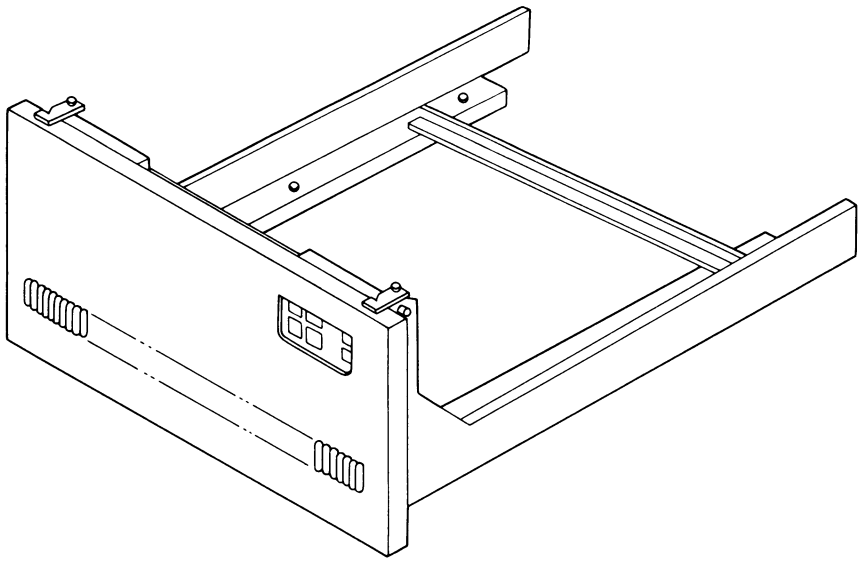
Figure 8-2 Power Supply Unit (B14L-5105-0180A#A1)

8.3 Operator Panel (B03B-4540-E352A)

This option is composed of mounting plates, a front panel, an operator switch, four shock rubbers, a flat cable between the mother board and the operator switch and two frame ground cables for standard 19 inches rack cabinet.

Slide rail is not included.

Refer to Figure 8-3.

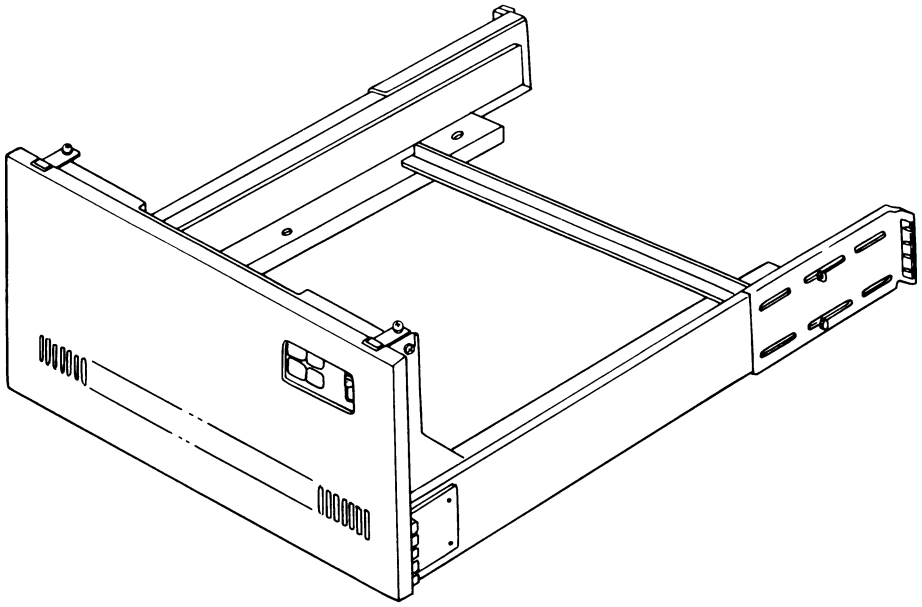


Note) Four shock rubbers, two frame ground cables and a flat cable (10P) are not shown in the above figure.

Figure 8-3 Operator Panel (B03B-4540-E352A)

8.4 Operator Panel and Slide Rail (B03B-4540-E353A)

This option is composed of operator panel before-mentioned (B03B-4540-E352A) and a pair of slide rail. The slide rail length is 24 inches (610 mm) to 30 inches (762 mm) adjustable. Refer to Figure 8-4.

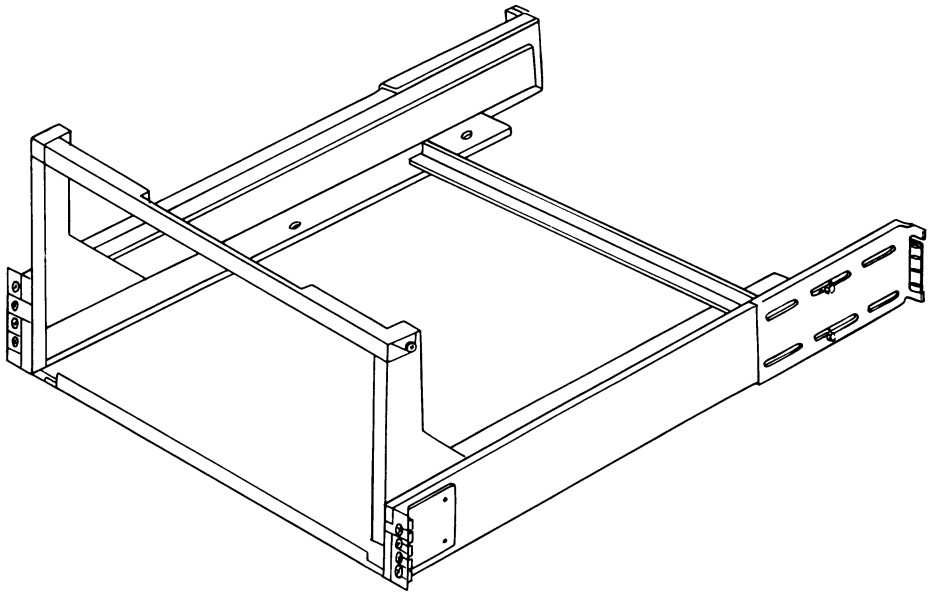


Note) Four shock rubbers, two frame ground cables and flat cable (10P) are not shown in the above figure.

Figure 8-4 Operator Panel and Slide Rail (B03B-4540-E353A)

8.5 Operator Panel and Slide Rail (B03B-4540-E354A)

This option is composed of mounting plates, a pair of slide rail (24 to 30 inches adjustable), four shock rubbers and two frame ground cables.



Note) Four shock rubbers and two frame ground cables are not shown in the above figure.

Figure 8-5 Operator Panel and Slide Rail (B03B-4540-E354A)

8.6 Slide Rail Kit (B030-4540-V450A)

This option is composed at a pair of slide rail and rear brackets.

8.7 Dual Port (B03B-4540-E901A)

This option is composed of a PCB assembly (XCBM), a cover plate, mounting plates, cables and screws. The dual port option is easily mounted onto the PCB chassis of basic drive by four screws.

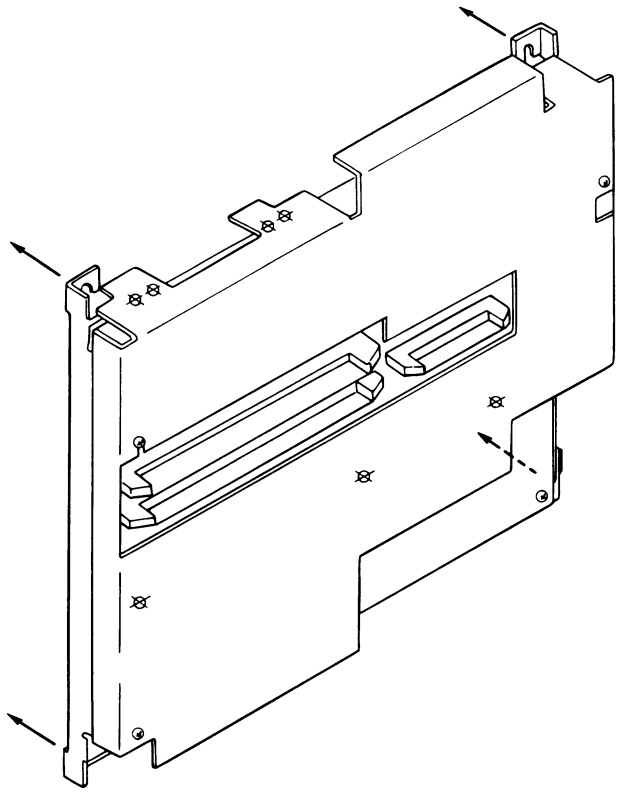


Figure 8-6 Dual Port

8.8 Rubber Shock Mount

This option is used for vertical mount configuration within the system cabinet. Refer to Item 5.1.2.

In this configuration, three rubber shocks are required for installation. The part number is specified by a piece.

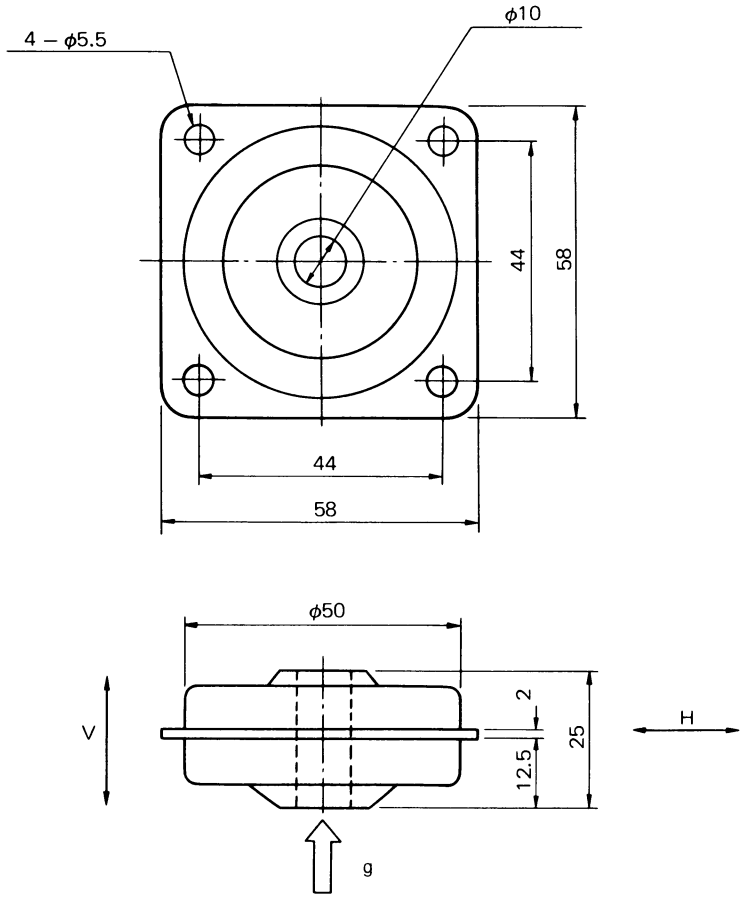
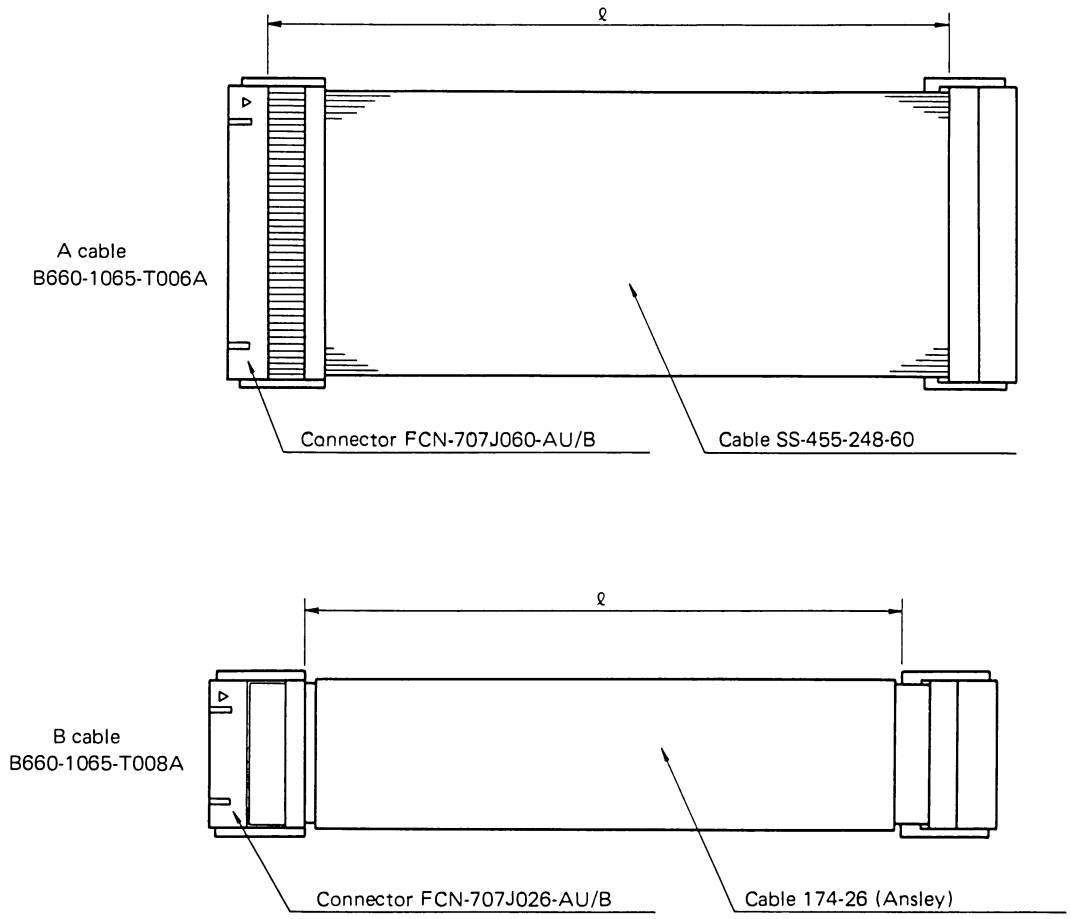


Figure 8-7 Rubber Shock Mount

8.9 Interface Cable

This option is used for the interface connection between the control unit and the disk drive. "A" cable can be specified from 1 m to 30 m in 20-inch increments, and "B" cable can be specified from 1 m to 15 m in 500 mm increments.



Example: B660-1065-T008A #3R503 (3.5m)
3.5×10^3mm

Figrue 8-8 Interface Cable

BLANK

9. SPARE PARTS

Table 9-1 Spare Parts List

Part Designation	Specification	Remarks
Disk Enclosure	B030-4540-T012A	
Spindle Drive Motor	B90L-0980-0002A	AC100V/115V *2
Spindle Drive Motor	B90L-0980-0004A	AC220V/240V *2
Belt	B30L-1000-0108A#L1026	
Anti-static Brush	B030-4420-W006A	*1
Speed Transducer	B030-4420-W030A	*1
Blower	B90L-1190-0001A	*1
Brake Relay	B58L-0170-0001A	*1
KGEM PCB Assembly	B16B-6160-0060A	
CWWM PCB Assembly	B16B-6150-0050A	*2
VOIM PCB Assembly	B16B-9820-0010A	
SDRM PCB Assembly	B16B-8990-0060A	
ROWM PCB Assembly	B16B-9000-0060A	

Notes 1) The spare parts marked by "*1" are commonly used with M228X and M2294 Disk Drive.

2) The spare parts marked by "*2" are commonly used with M2294 Disk Drive.

3) The spare parts without "*" are exclusively used for M2298 disk drive.

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10. INTERFACE

10.1 Introduction

10.1.1 Purpose

This section describes the logical and physical specifications for signal transfer within the interface between a M2298 Fixed Disk Unit (FDU) and the control unit.

10.1.2 Connection

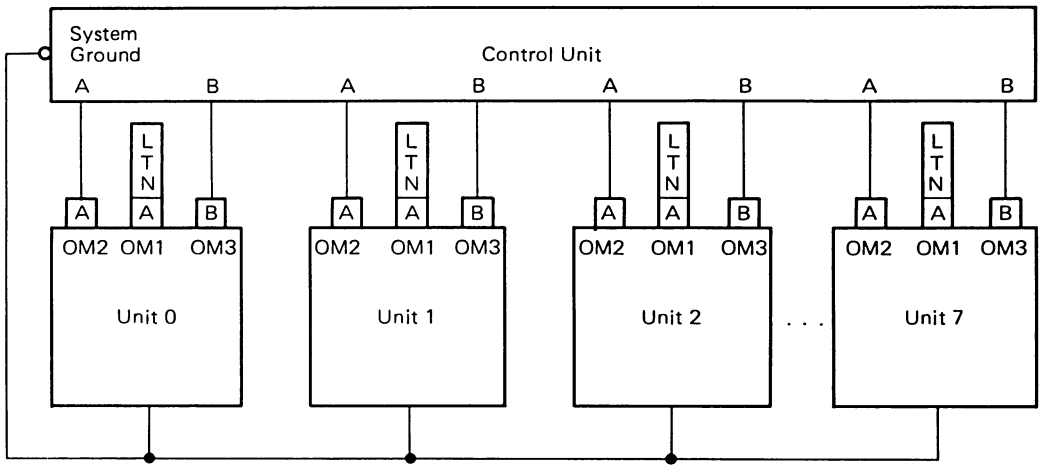
The external connection (for transmitting and/or receiving interface signals for the unit) consists of two connectors, "A" and "B", which are connected, respectively, to cables "A" and "B". "A" cables may be connected in a daisy-chain configuration. Therefore, a line terminator must be inserted into the "A" connector of the last device. "B" cables are connected in a star configuration. Therefore, the control unit requires "B" cables and connectors in proportion to the maximum number of units to be connected.

10.1.3 Timing Specifications

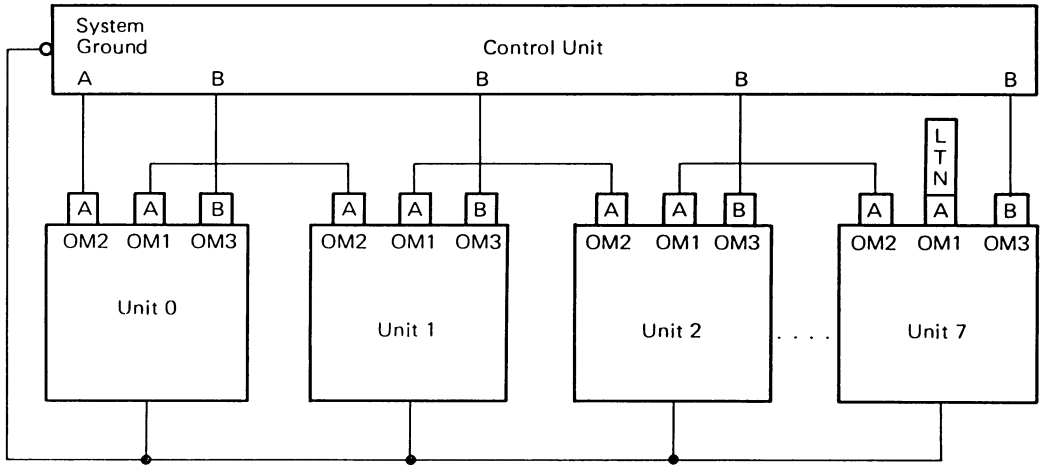
Timings are specified at the connector position of the unit. Accordingly, it is necessary for signal timings to consider both the delay time of the interface cable and the circuits of the disk control unit. Cable delay time will be described later.

10.1.4 Interface Transmitter/Receiver

Transmitters and receivers of SN75110 and SN75107 or equivalent are used to provide a terminated, balanced-line transmission system. Refer to Paragraph 10.7.



Star Cable Configuration



Daisy-Chain Cable Configuration

Notes: 1) Line terminators (LTN) are required on the control unit and each unit in a star cable configuration.

2) Line terminators are required on the control unit and last drive in a daisy-chain cable configuration.

Figure 10-1 Interface Cabling

10.3 Type and Name of Signal Lines

10.3.1 "A" Cable Lines for Balanced Transmission

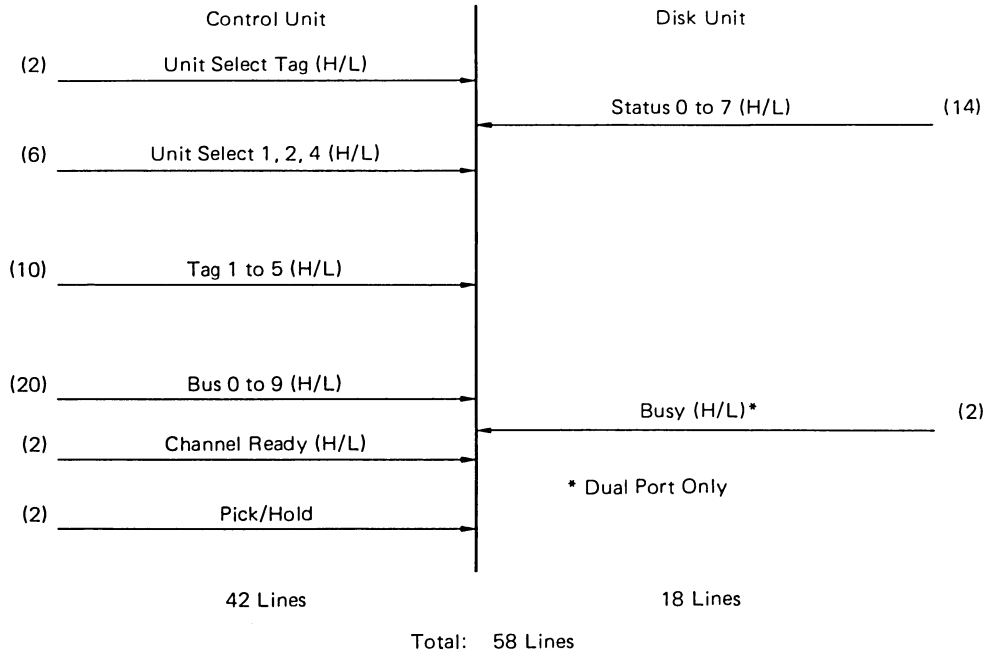


Figure 10-2 "A" Cable Signals

10.3.1 "B" Cable Lines for Balance Transmission

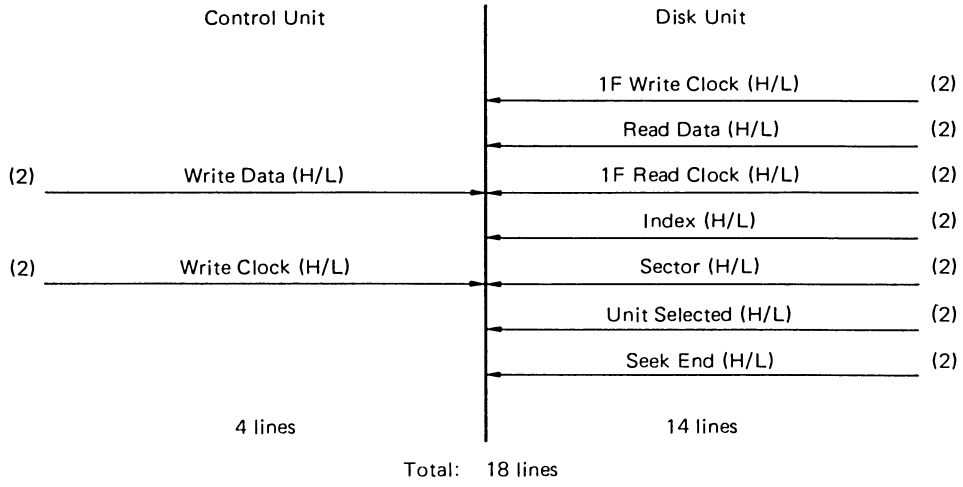


Figure 10-3 "B" Cable Signals

10.4 Description of Signal Lines

10.4.1 "A" Cable Input Signal

(1) Unit Select Tag

This signal gates Unit Select 1, 2 and 4 to select the desired disk. Refer to timing of Unit Select 1, 2 and 4 (Figure 10-4).

(2) Unit Select 1, 2 and 4

These three signals are binary coded to select the desired disk and are validated by the leading edge of Unit Select Tag. The logical disk number (0 through 7) is selectable by means of a switch circuit located on the PCB gate card.

(3) Tag 1 to 3 and Bus 0 to 9

Table 10-1 Tag/Bus Lines

Bus	Tag 1	Tag 2	Tag 3	Unit Select Tag 2*
	Cylinder Address	Head Address	Control Select	
0	1	1	Write Gate	—
1	2	2	Read Gate	—
2	4	4	Servo Offset Plus	—
3	8	8	Servo Offset Minus	—
4	16	—	Fault Clear	—
5	32	—	—	—
6	64	—	RTZ	—
7	128	—	—	—
8	256	—	—	—
9	512	—	Release 1*	Priority Select 1*

Note 1: Dual Port Only.

2: Validates (or gates) the Unit Select 1, 2, and 4 lines in addition to the dual port priority select lines.

1) Cylinder Address (Tag 1)

The cylinder address is set by Tag 1 and bus lines (Bus 0 to 9) on the unit. However, throughout Tag 1, the bus lines must be stable. Refer to Figures 10-6 and 10-7.

The unit must be On cylinder prior to Tag 1.

2) Head Address (Tag 2)

The head address is set by Tag 2 and Bus 0 to 3 on the unit; however, throughout Tag 2, Bus 0 to 3 must be stable. Refer to Figures 10-8 and 10-23.

3) Control Select

Bus lines 0 to 9 specified by Tag 3 have a different meaning in each bit. All signals are defined as control signals.

(a) Write Gate (Bus 0)

This signal enables the write operation on the specified track. This signal is validated under the following conditions:

Unit Ready	True
On Cylinder	True
Seek Error	False
Device Check	False
File Protect	False
Off Set	False

If Write Gate is turned on in cases other than the above-mentioned conditions, Device Check occurs and writing is inhibited. Refer to the definition of a Device Check.

(b) Read Gate (Bus 1)

This signal is used to recover data from the specified track. Refer to the timing of Read Gate, Read Data and 1F Read Clock in Figures 10-16, 10-18 and 10-19.

(c) Servo Offset Plus (Bus 2)

When Servo Offset Plus signal is true on the unit, the head is offset 3.0μm from nominal On Cylinder position away from the spindle. Refer to Figure 10-9. When going false of Servo Offset Plus, a 4ms delay is required before writing.

(d) Servo Offset Minus (Bus 3)

When Servo Offset Minus signal is true on the unit, the head is offset 3.0μm from nominal On Cylinder position towards the spindle. Refer to Figure 10-9. When going false of Servo Offset Minus, a 4ms delay is required before writing.

(e) Device Check Clear (Bus 4)

This signal clears the device check status, however, if sources of a device check still exist (refer to Device Check), this status is not cleared. Refer to Figure 10-10.

(f) RTZ (Return to Zero) (Bus 6)

No matter where the access heads are located on the media, they are returned to cylinder zero and head zero by the RTZ signal, also RTZ command resets the Fixed Lead Selected latch. This signal clears the Seek Error flip-flop. Refer to Figure 10-11.

(g) Release (Bus Bit 9)

Asserting this command will release Channel Reserve and Unconditionally Reserve in the drive, making alternate channel access possible after selection by the other channel ceases.

If the customer desires to function with Release Timer feature using Release Timer switch on the optional Dual Port PCB assembly, release will occur 500 ms (nominal) following the deselection of the drive. Refer to Figure 10-4 and Figure 10-5.

(4) Priority Select (Unit Select Tag-Bus Bit 9: Dual Port)

When the control unit issues Unit Select Tag and Bus Bit 9 with specified disk address, the disk drive will be unconditionally selected and absolutely reserved by the channel issuing this command providing both channels are enabled and a priority select condition does not exist on the opposite channel.

Once the drive is unconditionally reserved by Priority Select command, the respective channel has exclusive access to the drive. The opposite channel can access only after Release command has been issued by the selected channel. Refer to Figure 10-5.

When the drive is unconditonally reserved, all interface signals are inhibited on the opposite channel including Unit Selected and Busy signals.

(5) Channel Ready

This signal is used to prevent damage to the file caused by interface disturbances when the control unit power is lost. Therefore, this signal must be stable when the control unit is available, and must be disabled before logic levels decay at the interface lines when a power failure of the control unit occurs. Refer to Figure 10-12.

(6) Tag 4 and Tag 5 (Selectable)

When Tag 4 goes true, the unit issues Section Address Status signals on the Status 0 to 7 lines (bus lines 0 to 7).

When Tag 5 goes true, the unit issues Device Check Status signals on the Status 0 to 5 lines (bus lines 0 to 5).

When both Tag 4 and Tag 5 are true, the Device Type code will be issued in BCD on the Status 0 to 5 lines. Refer to Table 10-2 and Figure 10-13.

(7) Pick and Hold

Power Sequencing requires that the mode switch on the power supply unit be set to Remote.

When the control unit sets the Pick and Hold lines to ground, the first FDU starts up the power sequence. Once this FDU has reached nominal speed, the Pick signal is transferred to the next FDU, and repeated until all FDU's are powered up. When the mode switch on the power supply is set to Local, each FDU must be powered up manually.

10.4.2 A Cable Output Signals

(1) Status 0 to 7

The status 0 to 7 lines, when specified by Tag 4 and Tag 5, are shown in the following table. Usually Unit Status is available when Tag 4 and Tag 5 signals are false. Tag 4 and Tag 5 must be enabled with a short plug on the gate PCB in order to be utilized.

Table 10-2 Status Lines by Tag 4/5

Tag 4	False	True	False	True
Tag 5	False	False	True	True
Status	Unit Status	Sector Status	Check Status	Device Type
0	Unit Ready	Sector Address 1	Control Check 1	Device Type 1
1	On Cylinder	2	2	2
2	Seek Error	4	Offtrack check	4
3	Device Check	8	Write Echo Check	8
4	File Protected	16	File Protect Check	16
5	-	32	Multiple Head	32
6*	Index	64	-	64
7*	Sector	128	-	128

Refer to Figure 10-13 for the timing of Tag 4, Tag 5 and Status 0 to lines. Status bits 6/7 are available only for the basic configuration, not for dualport.

(a) Unit Status

1) Unit Ready

When this signal is true, the unit is selected, this signal indicates the unit is up to speed, and no fault condition exists within the unit.

2) On Cylinder

This line indicates the heads are located on the specified track (cylinder).

This status is cleared by the next seek or an RTZ instruction, and is set by completion of a seek or RTZ operation.

3) Seek Error

This signal indicates that a seek has occurred. In this case, the On Cylinder signal does not always go true. The Seek Error is cleared only by performing an RTZ (Tag 3 and Bus 6). Seek Error status is defined as follows:

- Seek was unable to complete a move within 640 ms.

- RTZ was unable to complete a move within 640 ms.

- The head was moved to a position outside the recording area.

- Heads have overshot the new cylinder address.

4) Device Check

This signal indicates that a fault condition exists in the unit. The following fault conditions may be detected by the unit.

- Control Check 1

  Instructions received during Not Ready Status.

- Control Check 2

  Instructions received during fault condition status. Write Gate received during off-set operation.

- Read/Write Check 1

  Write Gate received during Off-track status or VCM overheat has occurred.

- Read/Write Check 2

  Write fault or write current detected during a not-write operation.

- Read/Write Check 3

  Write Gate received during write protected status.

- Read/Write Check 4

  Write or Read Gate received when multiple heads are selected.

If an above-mentioned condition has occurred, writing is immediately inhibited and a Device Check signal is issued to the control unit.

The device check status is cleared by the following operations:

- Fault Clear on Tag 3 and Bus 4

- Fault Clear on the operator panel (if operator panel is employed).

- Fault Clear Switch on the PCB Gate

Device Check Status turns on the check LED on the operator panel as well as Maintenance Aid LED's on PCB chassis.

5) File Protected

File protected signal indicates write-protected status. The File Protect function is enabled by the following switches:

- File Protect Switch on the operator panel (option).
- File Protect Switch on the PCB gate.

Attempting to write while protected will cause a Device Check (File Protected Check) to be issued to the control unit.

(b) Sector Address 1 to 128 (Status Lines 0 to 7)

Eight-bits of binary-coded Sector Address are transferred from the Sector Counter, reset by the trailing edge of Index, clocked by the trailing edge of Sector, and indicate the current sector address in the unit. Sector Address (Status Lines 0 to 7) will be issued to the control unit by activating Tag 4. Refer to Figure 10-14 for the timing of Sector Address (status lines 0 to 7).

(c) Device Check (Status 0 to 7)

Refer to item (a)-4).

(d) Device Type 1 to 32 (Status lines 0 to 7)

Enabling selectable Tag 4 and Tag 5 lines, causes key-selected Device Type Status to be issued to the control unit as Status 0 to 7 signals. Binary-coded Device Type Signals are specified as shown in Table 10-3.

Table 10-3 Device Type Code

Device Type	Code (Hexadecimal)	Status							
		7	6	5	4	3	2	1	0
		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
M2298	20	0	0	1	0	0	0	0	0

Notes: 0: False
1: True

(2) Index

This signal occurs once per revolution and is used for reference in read/write operation. Refer to Figure 10-14 for the timing of Index and Sector.

(3) Sector

The Sector mark is derived from the servo track. The number of sectors per revolution is switch selectable and is determined by counting Byte Clock. The switches are located on the VFO/PLO card within the PCB chassis. Refer to paragraph 5.4.4.

(4) Busy (Dual Port Only)

If the drive is already selected and/or reserved, a Busy signal will be issued to the "A" cable and the Unit Selected signal will be issued to the "B" cable of the channel attempting the select function. The Busy signal will remain until the Unit Select Tag is negated or the drive is no longer busy. Unit Selected signal should be used to enable Busy in the control unit. Refer to Figure 10-4.

10.4.3 "B" Cable Input Signal

(1) Write Data

This line carries NRZ data which is to be written on the disk surface and must be synchronized with Write Clock. Refer to Figure 10-15.

(2) Write Clock

Write Clock is a return signal of the 1F Write Clock issued from the unit, and must be synchronized with the NRZ Write Data. Refer to Figure 10-15.

10.4.4 "B" Cable Output Signal

(1) 1F Write Clock

This signal is used by the control unit to synchronize Write Data and Write Clock. 1F Write Clock is available during Unit Ready Status except during read operations. Refer to Figure 10-15.

(2) Read Data

This line transmits the recovered data in the form of NRZ data synchronized with 1F Read Clock. Refer to Figure 10-16.

(3) 1F Read Clock

This line transmits 1F Read Clock which defines the beginning of a bit cell. The Read Data is synchronized with the 1F Record Clock. Refer to Figure 10-16.

(4) Unit Selected

When the three unit select lines compare with the logical address of the unit, and when the leading edge of Unit Select Tag is received, the Unit Selected Signal goes true and is issued to the control unit. This signal also activates all status lines at the "A" cable.

(5) Seek End

Seek End signal is a combination of On Cylinder and Seek Error indicating that a Seek RTZ, or Offset operation has terminated.

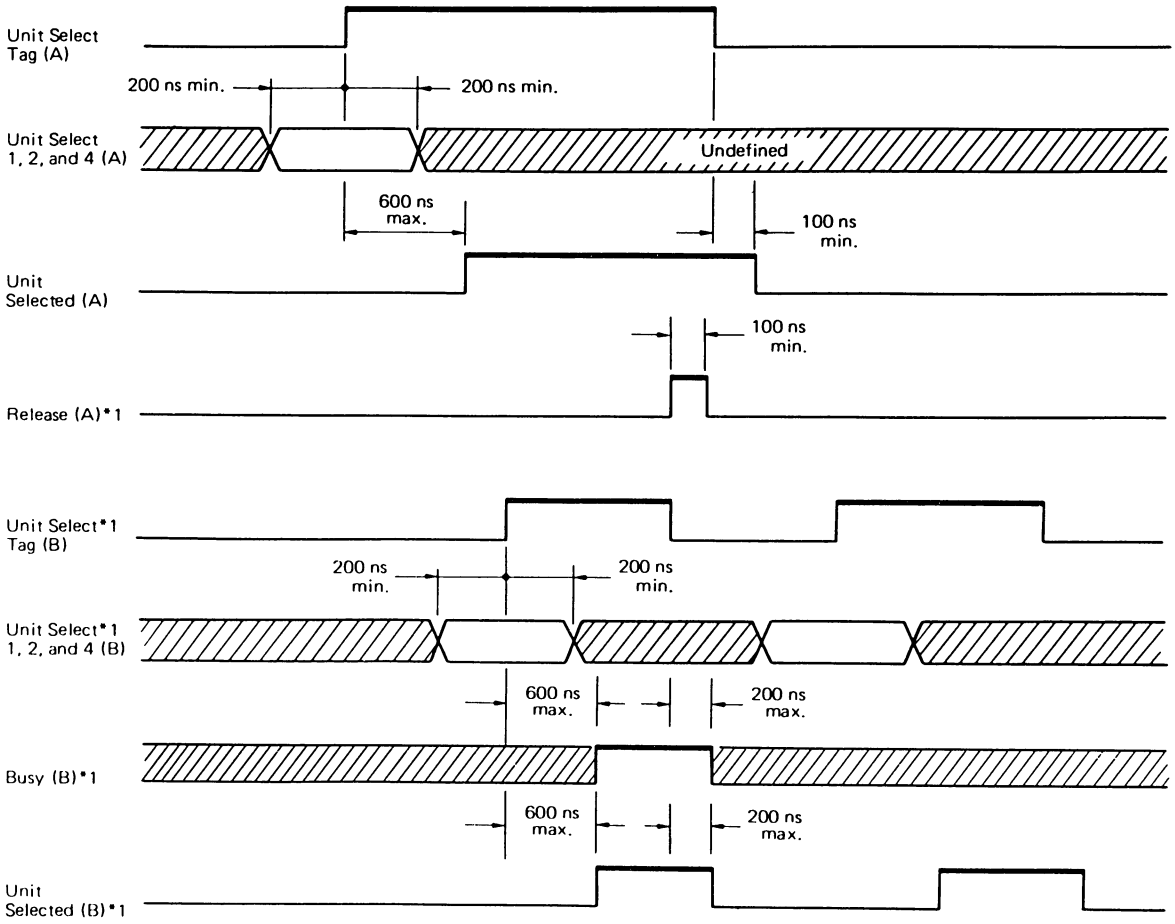
In the Dual Port function, the Seek End signal sent to the unselected channel will normally be a constantly true signal level. However, if the drive is selected by one channel, and the other channel receives a select, the Seek End signal sent to the waiting channel will go false for 30μs, when the Select and Reserve latches are reset on the selected channel.

(6) Index, Sector

The Index and Sector pulses are issued on the interface for reference during read/write operation.

10.5 Control Timing

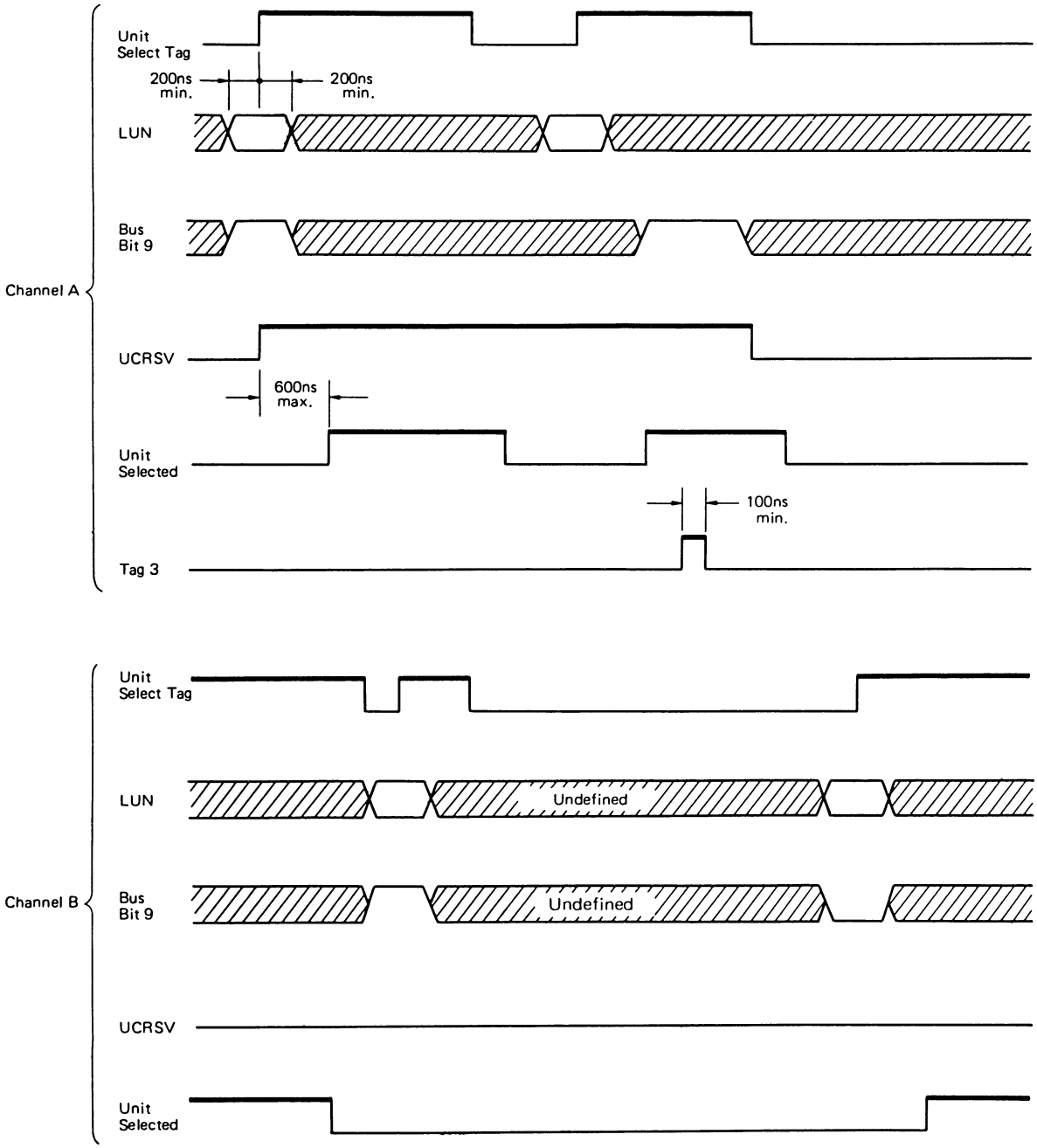
10.5.1 Unit Selection



Note: *1 Dual Port only.

Figure 10-4 Unit Select Timing

10.5.2 Priority Select Timing (sample)



Notes: 1) LUN: Logical Unit Number (Unit Select 1, 2 and 4).

2) UCRSV: Unconditionally Reserved (Priority Selected).

3) Sample Sequence is as follows:
CHB Selected → CHA Priority Select →
CHB Priority Select → CHA Release → CHB Select

Figure 10-5 Priority Select Timing

10.5.3 Seek Timing

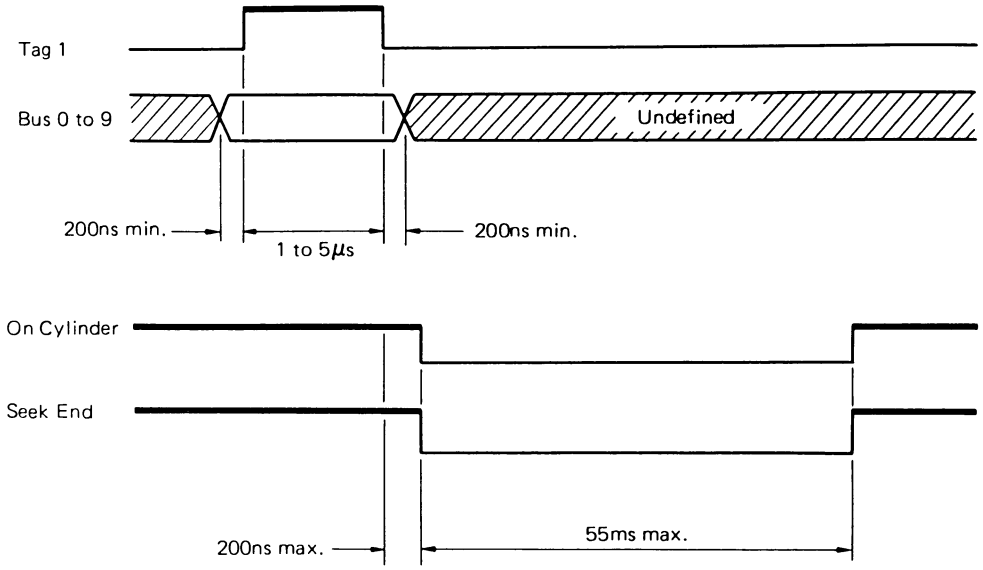


Figure 10-6 Seek Timing

10.5.4 Zero Track Seek (Access Area)

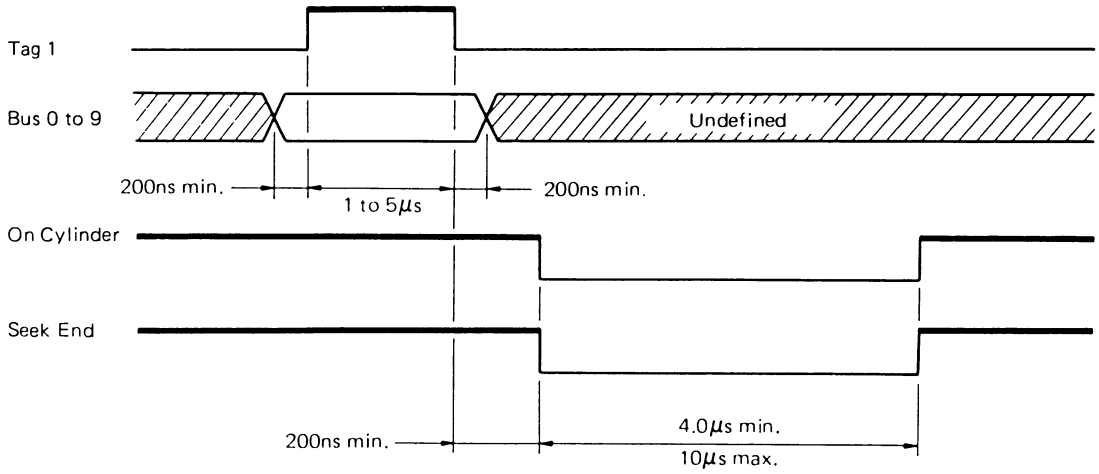


Figure 10-7 Zero Track Seek Timing

10.5.5 Tag 1 to Tag 2 Timing

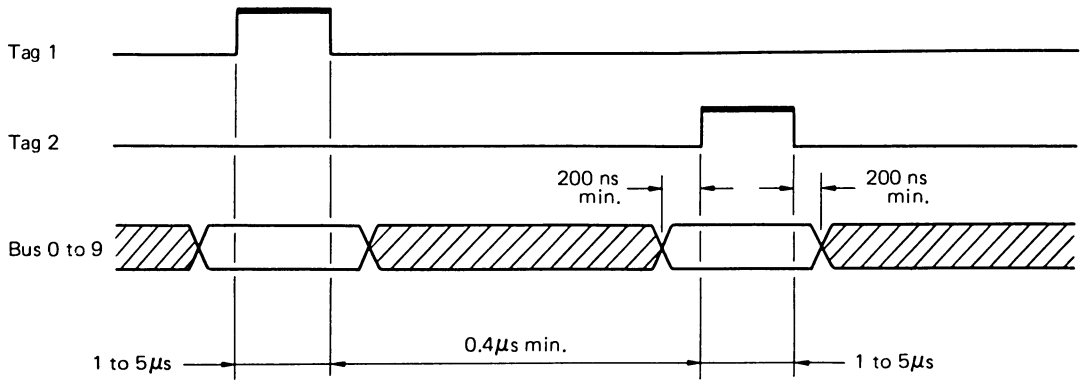
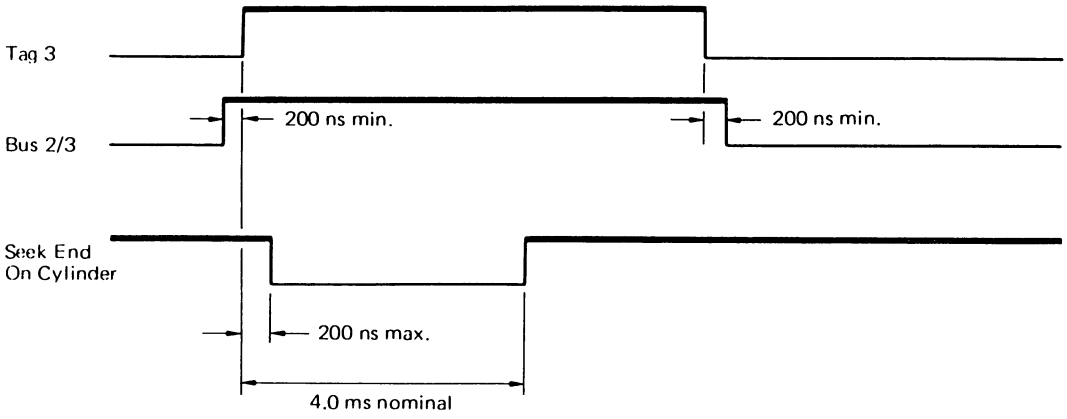


Figure 10-8 Tag 1 to Tag 2 Timing

10.5.6 Offset Plus/Minus Timing



Note: The control unit must inhibit the write operation for 4ms after offset end sequence.

Figure 10-9 Offset Plus/Minus Timing

10.5.7 Device Check (Fault) Clear Timing

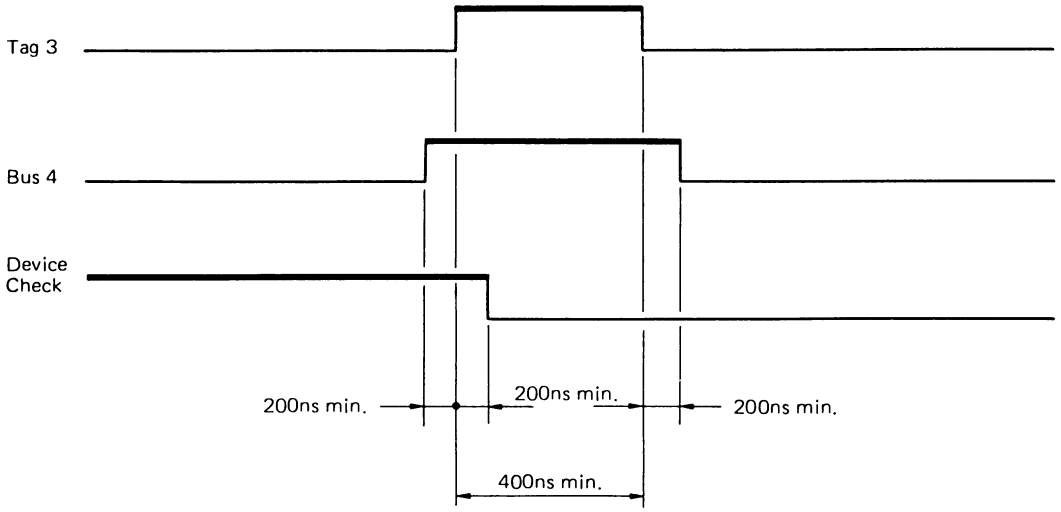
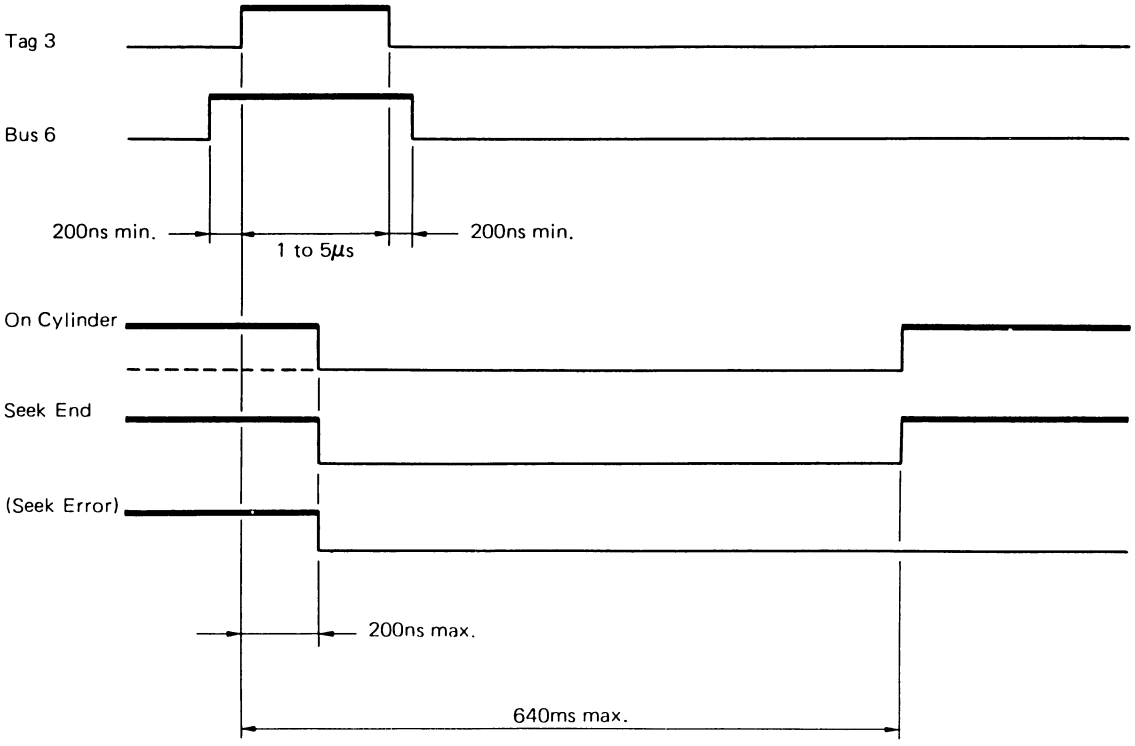


Figure 10-10 Fault Clear Timing

10.5.8 RTZ Timing



Note: On Cylinder is not always set at Seek Error.

Figure 10-11 RTZ Timing

10.5.9 Channel Ready Timing

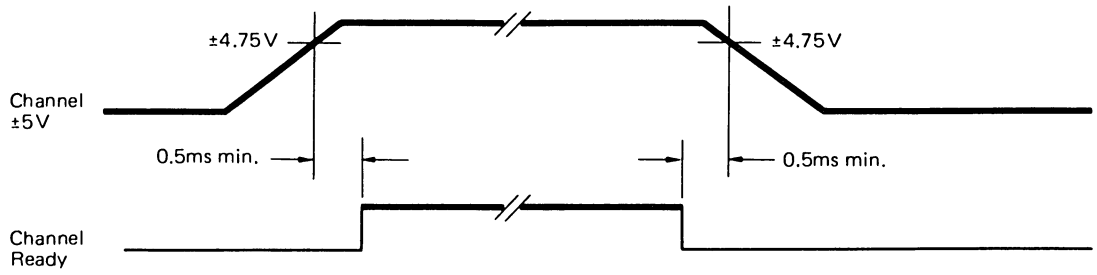


Figure 10-12 Channel Ready Timing

10.5.10 Tag 4/5 and Status 0 to 5 (optional) Timing

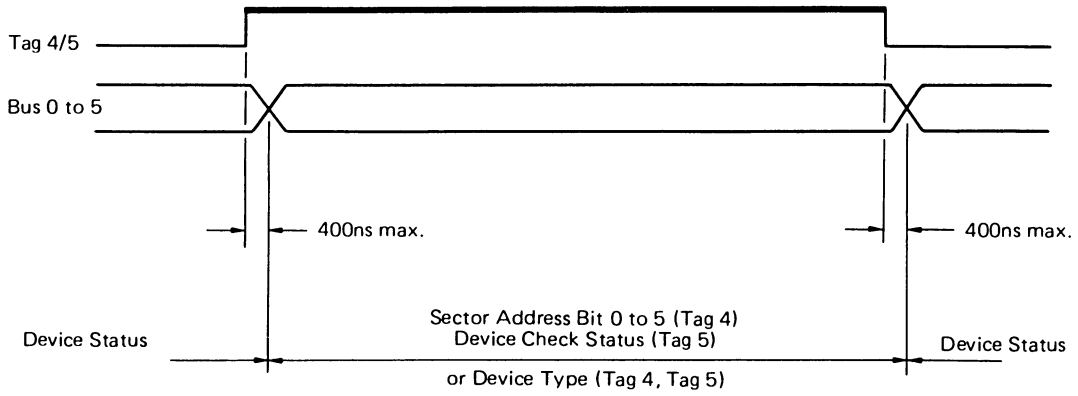


Figure 10-13 Tag 4/5 Timing

10.5.11 Index/Sector Timing

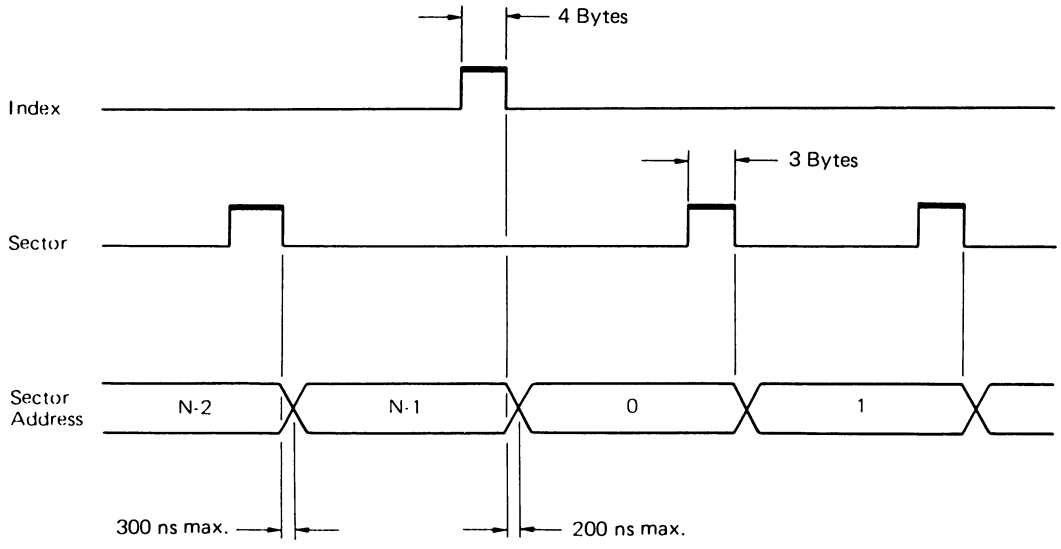
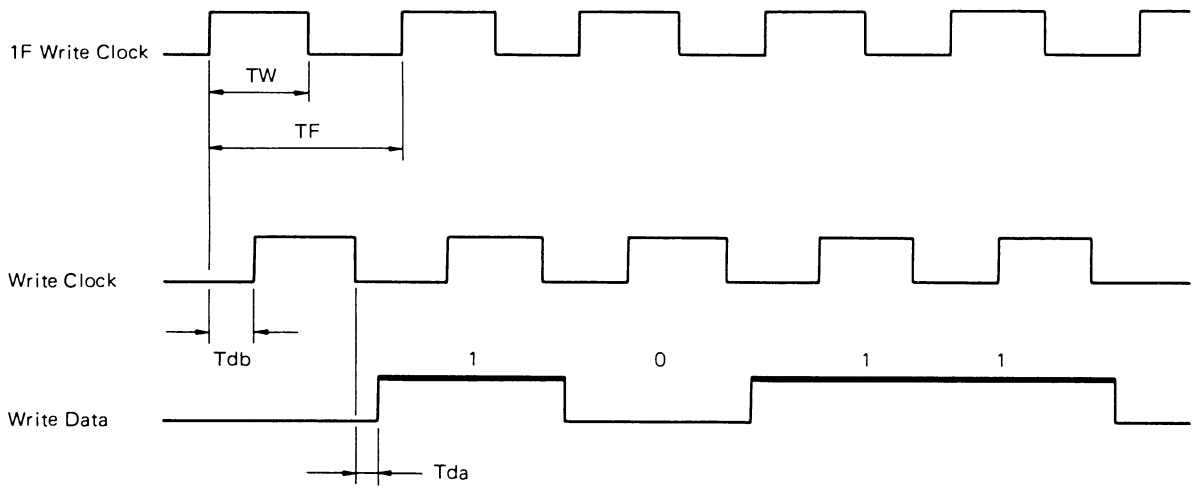


Figure 10-14 Index and Sector Timing

10.5.12 1F Write Clock, Write Data/Write Clock Timing



TW = TF/2

TW = 67.2 ns ± 3.4 ns

Tdb = Continuous delay within 2 bits

Tda = 0 ± 15 ns

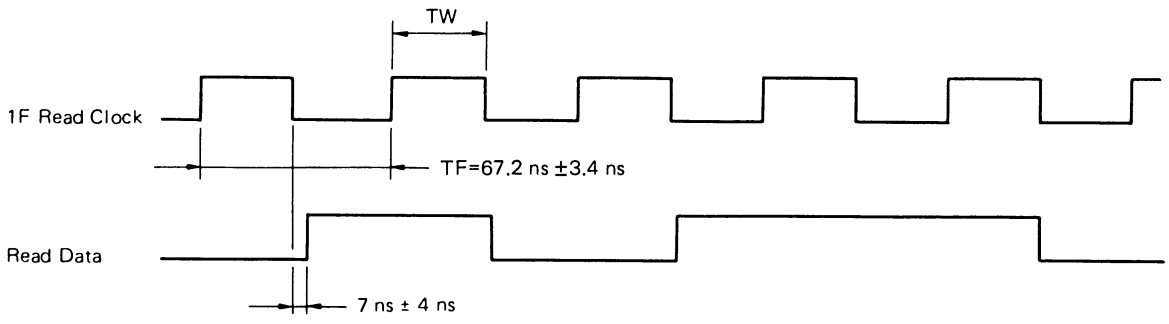
Note: 1) Write Data and Write Clock timing shall be specified at the output connector of the control unit.

2) The permissible value of TF = 67.2 ns 3.4 ns is about ±5%, which includes the rotational speed ±4% and the servo jitter ±1%.

3) NRZ Write Data issued from the control unit is write-compensated and then 2/7-modulated for writing on the disk surface.

Figure 10-15 Write Data and Write Clock Timing

10.5.13 Read Clock/Read Data Timing



TW = TF/2

Note: 1) 1F Read Clock and Read Data timing shall be specified at the output connector of the disk unit.

2) Read Data signal should be clocked at the positive-going edge of 1F Read Clock on the control unit.

Figure 10-16 1F Read Clock and Read Data Timing

10.6 Read/Write Timing

10.6.1 Format Write

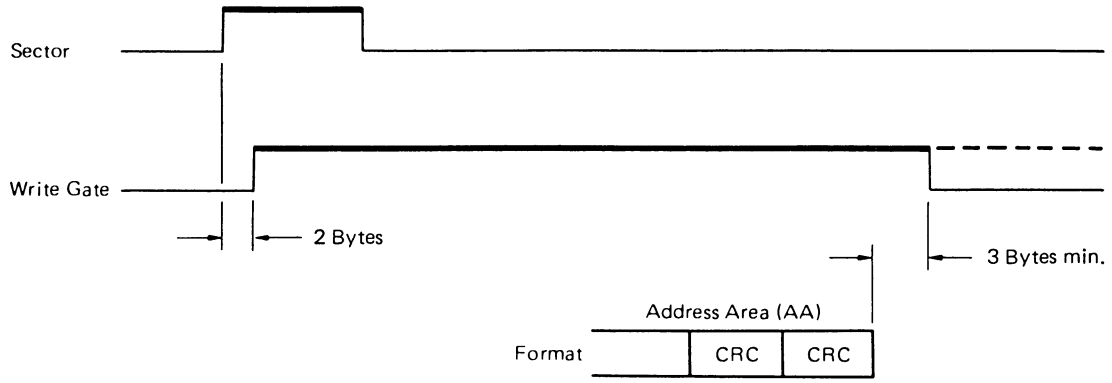


Figure 10-17 Format Write Timing

10.6.2 Data Write

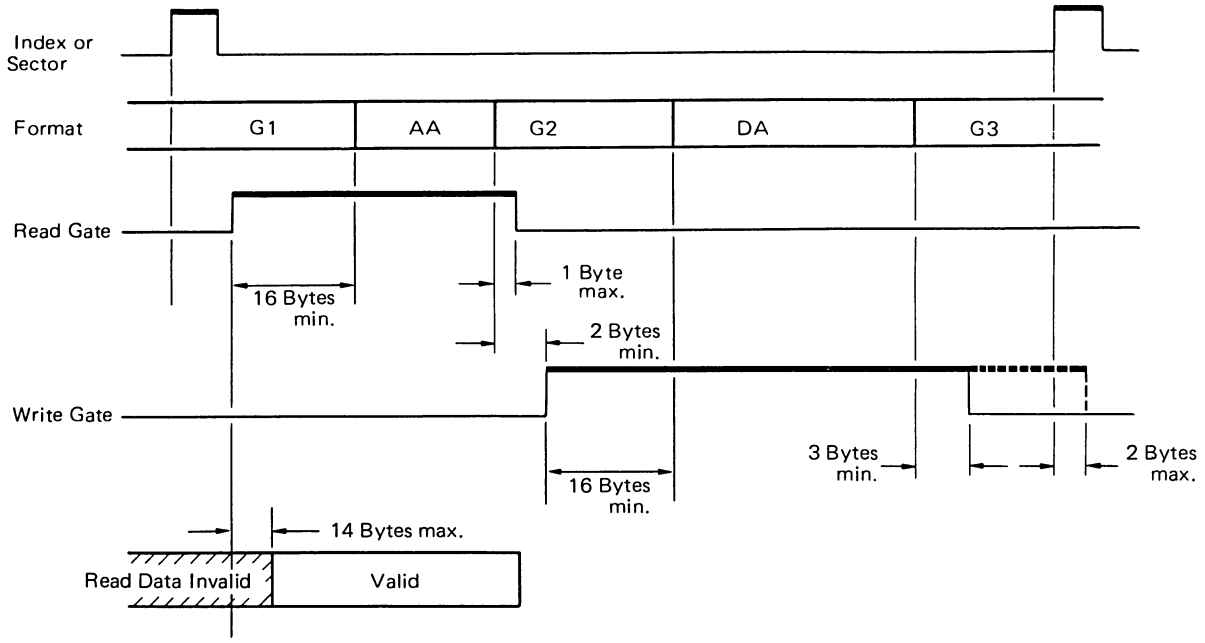
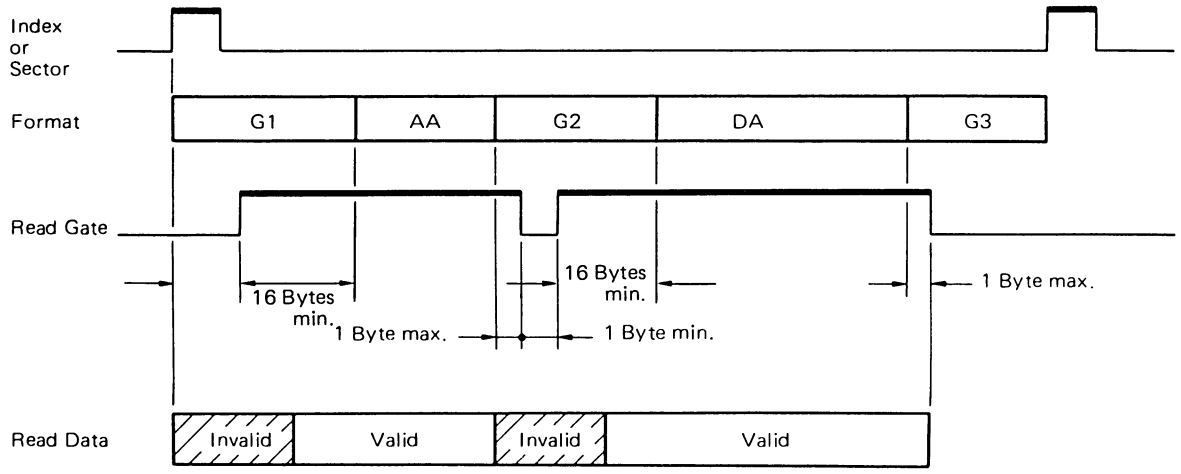


Figure 10-18 Write Data Timing

10.6.3 Data Read



Note: 1) The invalid data in the above figure is inhibited in the unit; therefore, it may be disregarded in the control unit.

2) The timing for switching to 1F Read Clock should be performed after the invalid data. In this case, a phase adjustment is required for 1 or 2 bits.

Figure 10-19 Read Data Timing

10.6.6 Write-To-Read Recovery Time

Refer to Figure 10-22. When head selection has been stabilized, the recovery time before Read Gate can be enabled after Write Gate goes false is 10μs minimum.

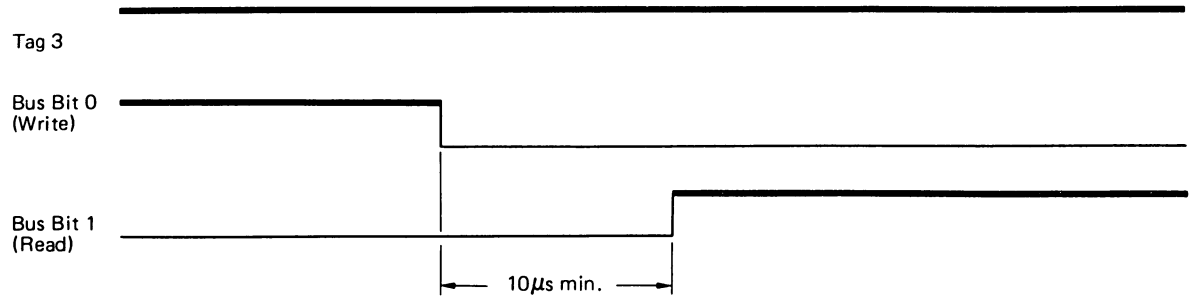


Figure 10-20 Write-To-Read Recovery Time

10.6.7 Head Select Transient

Refer to Figure 10-23. There is a 5μs delay within the disk drive due to circuit characteristics between the deselection of one head and the selection of another head.

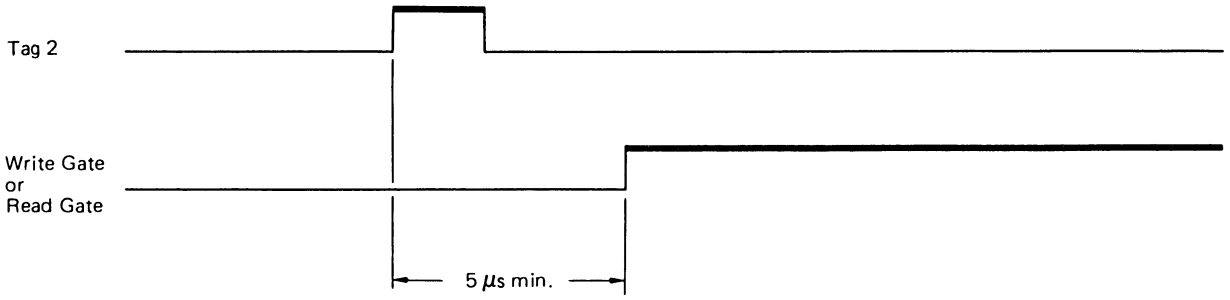
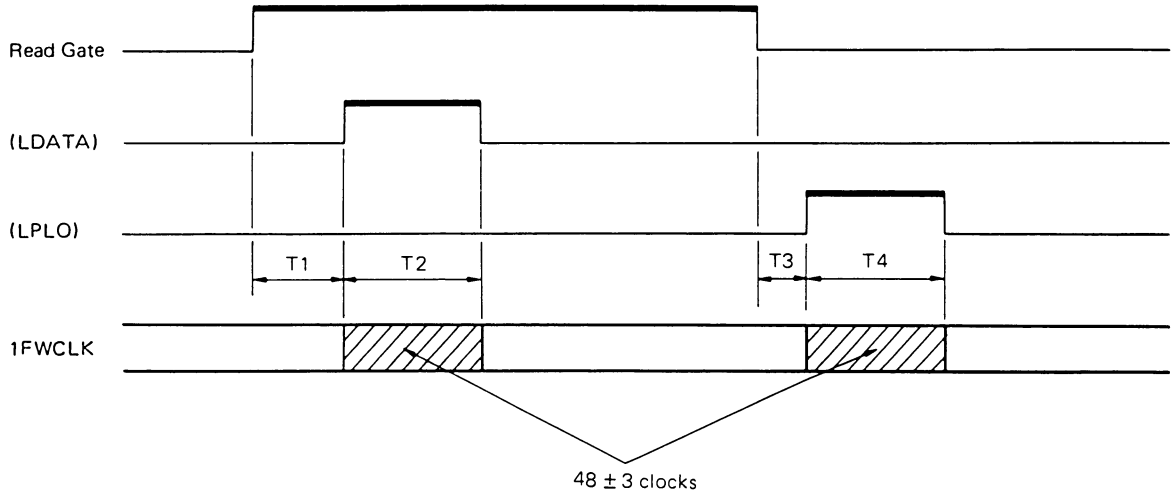


Figure 10-21 Head Select Transient

10.6.8 1F Write Clock in Reading

In the read operation, the 1F Write Clock signal fluctuates sightly within the Lock-To-Data or Lock-To-PLO signal (internal signal of Variable Frequency Oscillator circuit), in shown as Figure 10-24.



T1 : 56 bits;
T2/T4 : 48 bits (6 Bytes);
T3 : 2 to 8 bits.

Figure 10-22 1F Write Clock in Reading

10.6.9 Head Address Change at the Last Gap

This timing is specified for the customer who performs a head address change on the same cylinder in the last gap (Gap 3) of the sector.

The customer who does not require this timing should use the timings of items.

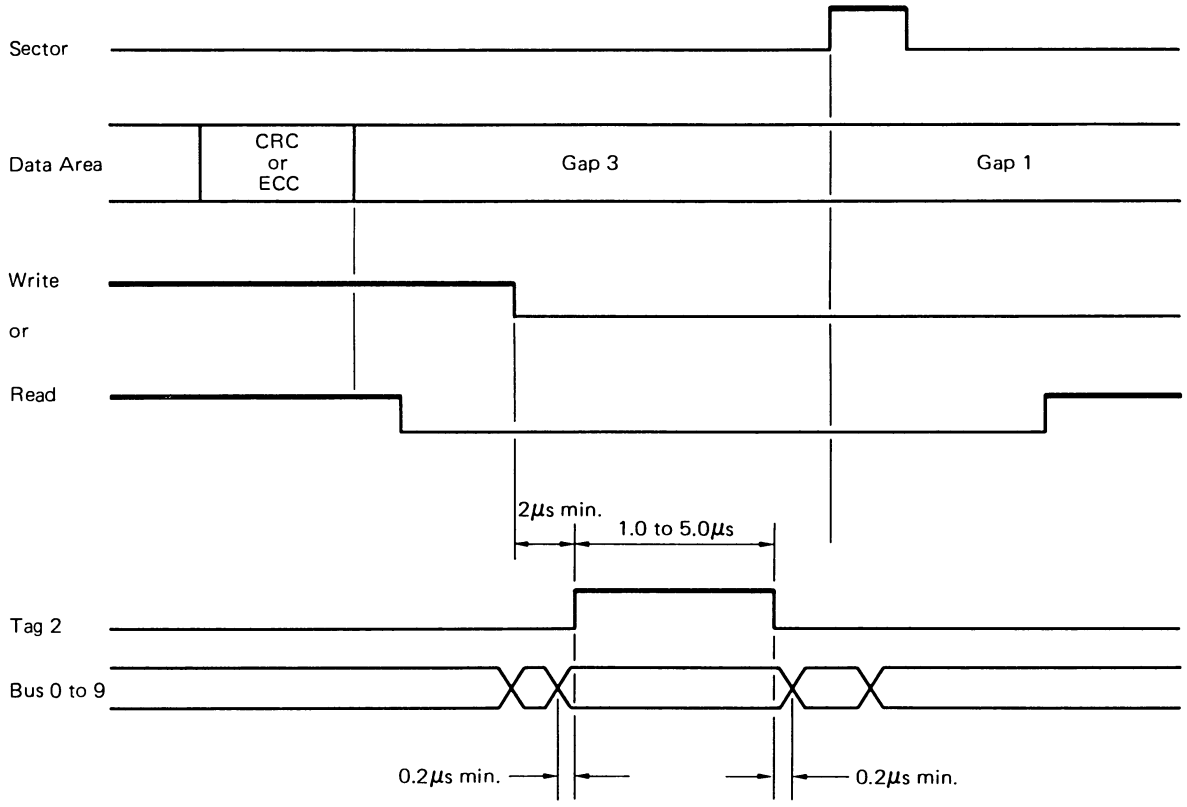


Figure 10-23 Head Address Change at the Last Gap

10.7 Interface Transmission

10.7.1 Driver and Receiver

Transmitters and receivers of SN75110 and SN75107 or equivalent are used to provide a terminated, balanced-line transmission. The Driver is SN75110 or equivalent, and the Receiver is SN75107/SN75108 or equivalent.

(1) Driver

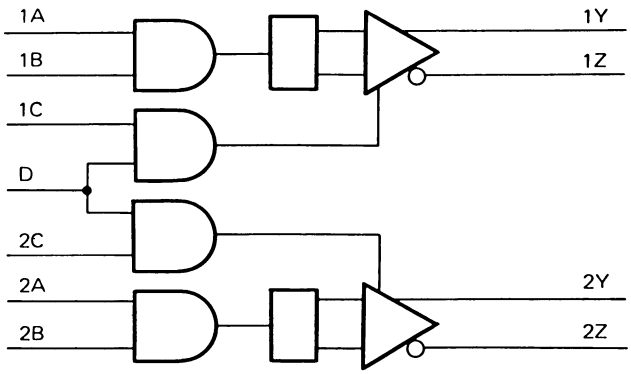


Figure 10-24 Drive Logic Diagram (SN75110)

Table 10-4 SN75110 Function Table

Logic Inputs		Inhibit Input		Outputs	
A	B	C	D	Y	Z
X	X	L	X	OFF	OFF
X	X	X	L	OFF	OFF
L	X	H	H	ON	OFF
X	L	H	H	ON	OFF
H	H	H	H	OFF	ON

Note: H-High Level, L-Low Level, X-Irrelevant.

(2) Receiver

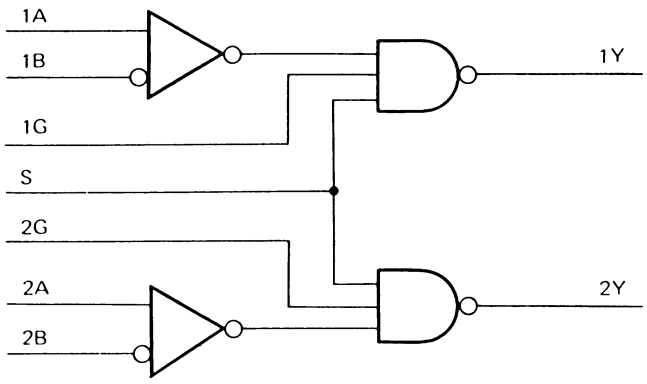


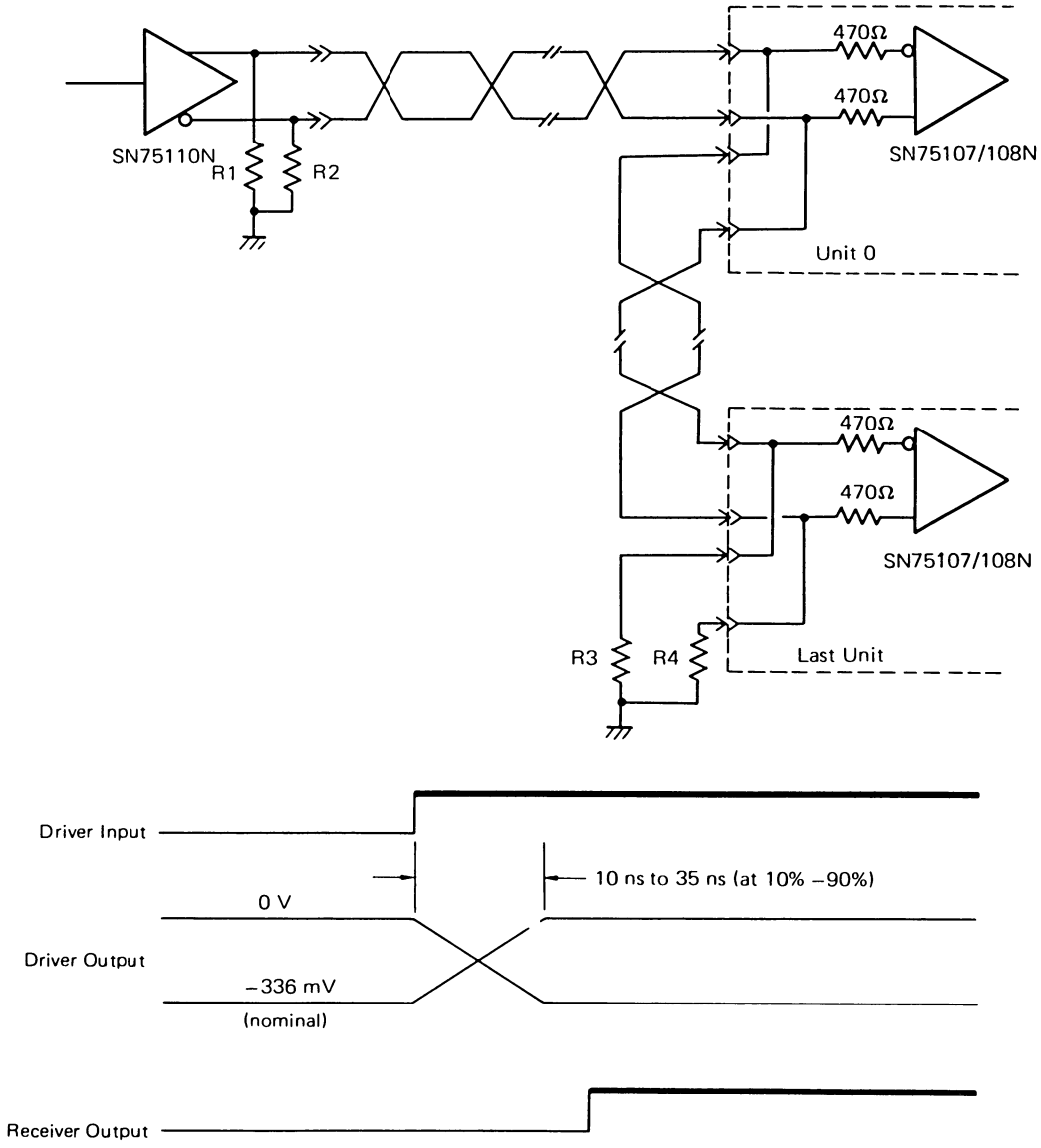
Figure 10-25 Receiver Logic Diagram (SN75107/75108)

Table 10-5 SN75107/75108 Function Table

Differential Inputs	Strobes		Output Y
	G	S	
A - B $\geq$ 25mV	X	X	H
-25mV < A - B < 25mV	X	L	H
	L	X	H
	H	H	Indeterminate
A - B $\leq$ -25mV	X	L	H
	L	X	H
	H	H	L

Note: H-High Level; L-Low Level; X-Irrelevant

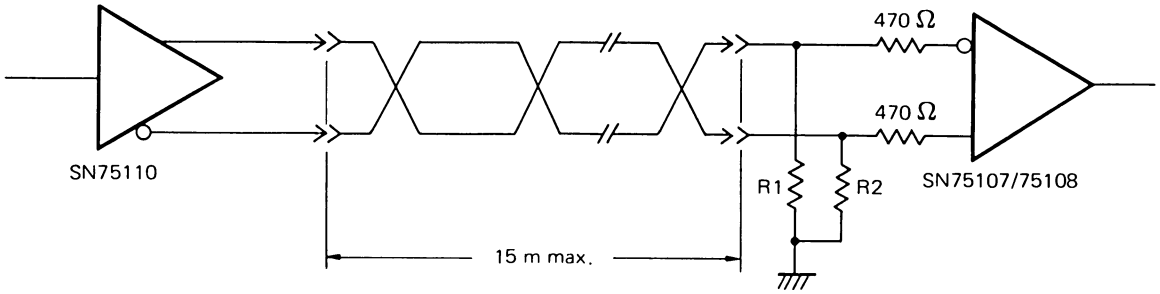
10.7.2 "A" Cable (Control Cable) Transmission

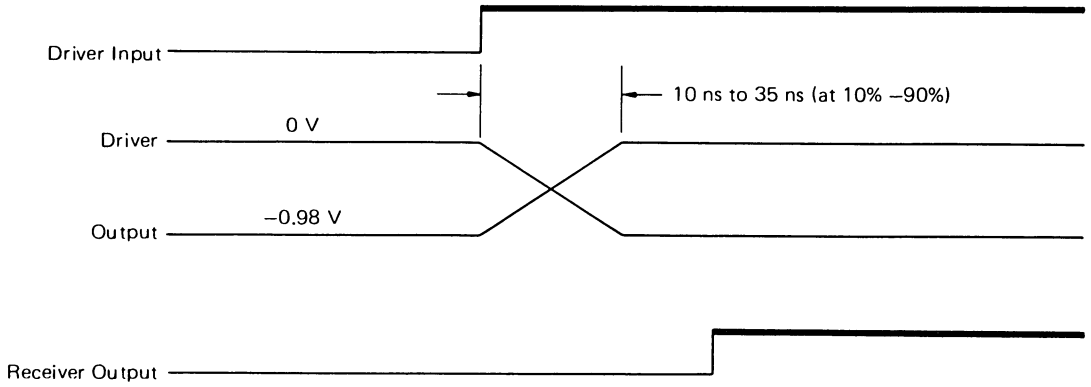


Notes:
1) Line terminators are located on the unit and the controller. R1 to R4: 56Ω ± 5%, 1/10W.
2) A line terminator is located on the terminator assembly of the last unit in the daisy chain configuration.
3) The maximum cable length is 30 meters.

Figure 10-26 Balanced Transmission of "A" Cable

10.7.3 "B" Cable (Data Cable) Transmission





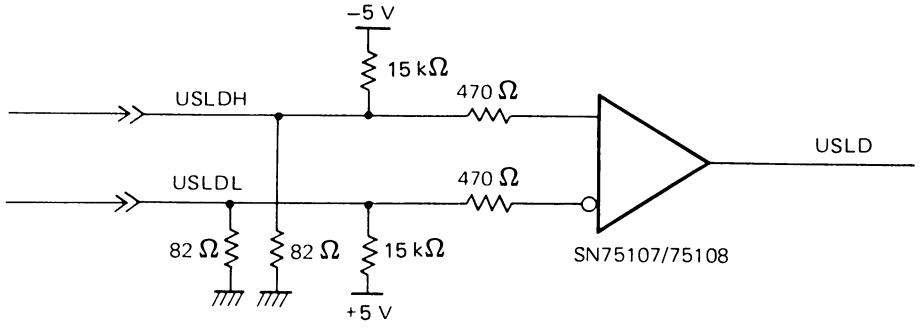
a) Balanced Transmission of "B" Cable

Note: 1) Cable shall be flat with characteristic impedance of 100 ± 10 ohms.

2) Line terminators are located on the receivers at the drive or control unit. R1 and R2 are 82 ohms ±5%, 1/10W.

3) The protect resistors (470 ohms) should be located on the receiver side. 470Ω ± 5%, 1/10W

4) A bias network should be used to prevent disturbance conditions by power failure at the control unit end of Unit Selected and Seek End signals as in b).



b) Bias Network to Prevent Power Failure Disturb

Figure 10-27 Balanced Transmission of "B" Cable

10.7.4 Channel Ready Driver

The Channel Ready signal must be issued so that data is protected during a power failure of the control unit. Relay logic and passive terminations sometimes aid this requirement. If SN75110A drivers are used to drive the Channel Ready signal from the control unit, dual drivers should be connected in parallel, and no 56 ohm termination to ground should be used at the control unit.

10.8 Connector and Cable

10.8.1 Connector

(1) "A" Cable Connector 60 pos.

	Ansley	Fujitsu
Unit Side:	609-6052MR	FCN-702P060-AU/M (Write wrapping)
	-	FCN-704P060-AU/M (Straight)
	-	FCN-705P060-AU/M (Right Angle)
Cable Side:	609-6001M	FCN-707J060-AU/B

(2) "B" Cable Connector 26 pos.

	Ansley	Fujitsu
Unit Side:	609-2652M	FCN-702P026-AU/M (Wire wrapping)
	-	FC -704P026-AU/M (Straight)
	-	FCN-705P026-AU/M (Right Angle)
Cable Side:	609-2601M	FCN-707J026-AU/B

10.8.2 Cable

(1) "A" Cable

SS-455-248-60 SPECTRA STRIP

ZO = 100Ω ± 10Ω, 28 AWG, 7 strands

(2) "B" Cable

174-26 Ansley, 3476-26 3M

ZO = 100Ω ± 15Ω, 28 AWG, 7 strands

10.9 Connector Pin Assignment

10.9.1 "A" Cable Connector 60 Pin

Table 10-6 "A" Cable Pin Assignment

1	Tag 1 L	31	Tag 1 H
2	Tag 2 L	32	Tag 2 H
3	Tag 3 L	33	Tag 3 H
4	Bus 0 L	34	Bus 0 H
5	Bus 1 L	35	Bus 1 H
6	Bus 2 L	36	Bus 2 H
7	Bus 3 L	37	Bus 3 H
8	Bus 4 L	38	Bus 4 H
9	Bus 5 L	39	Bus 5 H
10	Bus 6 L	40	Bus 6 H
11	Bus 7 L	41	Bus 7 H
12	Bus 8 L	42	Bus 8 H
13	Bus 9 L	43	Bus 9 H
14	Channel Ready L	44	Channel Ready H
15	Status 3 L	45	Status 3 H
16	Status 2 L	46	Status 2 H
17	Status 1 L	47	Status 1 H
18	Status 6 L	48	Status 6 H
19	Status 0 L	49	Status 0 H
20	Status 5 L	50	Status 5 H
21	Busy L	51	Busy H
22	Unit Select Tag 1	52	Unit Select Tag H
23	Unit Select 1 L	53	Unit Select 1 H
24	Unit Select 2 L	54	Unit Select 2 H
25	Status 7 L	55	Status 7 H
26	Unit Select 4 L	56	Unit Select 4 H
27	Tag 5 L (Selectable)	57	Tag 5 H (Selectable)
28	Status 4 L	58	Status 4 H
29	(Pick)	59	(Hold)
30	Tag 4 L (Selectable)	60	Tag 4 H (Selectable)

10.9.2 "B" Cable Connector 26 Pin

Table 10-7 "B" Cable Pin Assignment

1	GND	14	1F Write Clock H
2	1F Write Clock L	15	GND
3	Read Data L	16	Read Data H
4	GND	17	1F Read Clock H
5	1F Read Clock L	18	GND
6	Write Clock L	19	Write Clock H
7	GND	20	Write Data H
8	Write Data L	21	GND
9	Unit Selected H	22	Unit Selected L
10	Seek End L	23	Seek End H
11	GND	24	Index H
12	Index L	25	GND
13	Sector L	26	Sector H